



United States  
Department of  
Agriculture

Soil  
Conservation  
Service

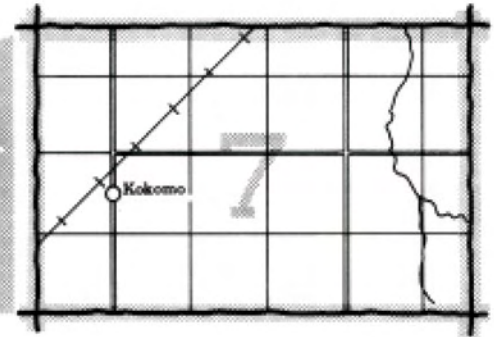
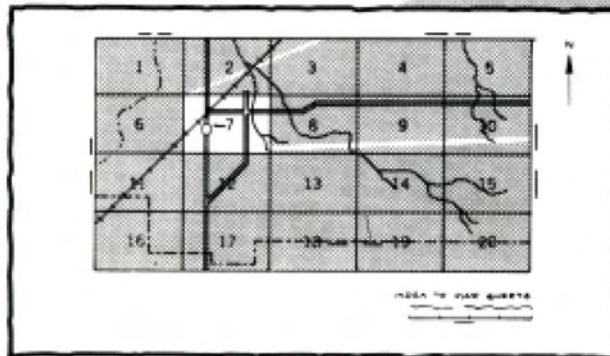
In cooperation with the  
Research Division of the  
College of Agricultural  
and Life Sciences,  
University of Wisconsin

# Soil Survey of Waupaca County Wisconsin



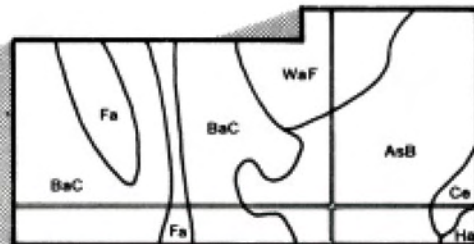
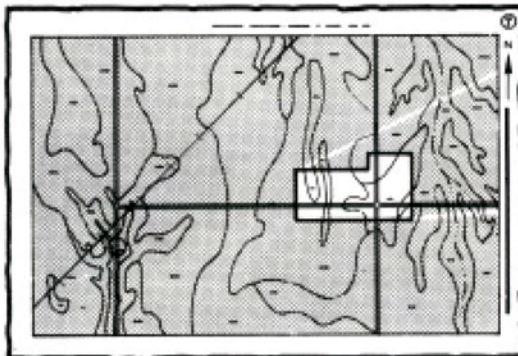
# HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

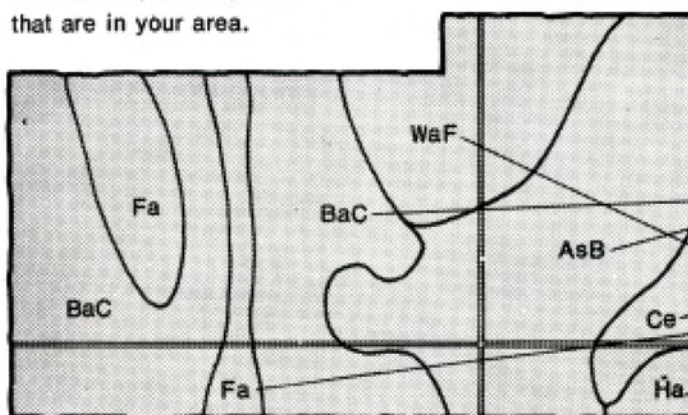


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



4. List the map unit symbols that are in your area.

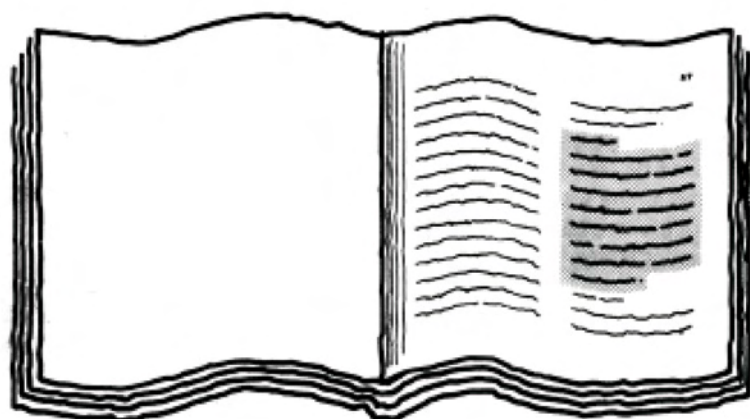


## Symbols

AsB  
BaC  
Ce  
Fa  
Ha  
WaF

# THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.

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- 6.** See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.

[illegible]

- 7.** Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

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This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This soil survey was made by the Soil Conservation Service in cooperation with the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin. It is part of the technical assistance furnished to the Waupaca County Land Conservation Committee. The fieldwork was partly financed by the committee. Major fieldwork was completed in 1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

This soil survey supersedes a soil survey of Waupaca County published in 1920.

**Cover: A typical area in Waupaca County. The contour stripcropping is on Rosholt soils, and the trees in the center are on Minocqua soils. The wetlands along the stream are Cathro and Markey soils.**

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# Foreword

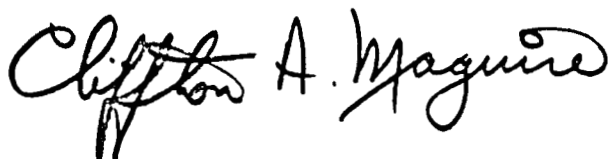
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This soil survey contains information that can be used in land-planning programs in Waupaca County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

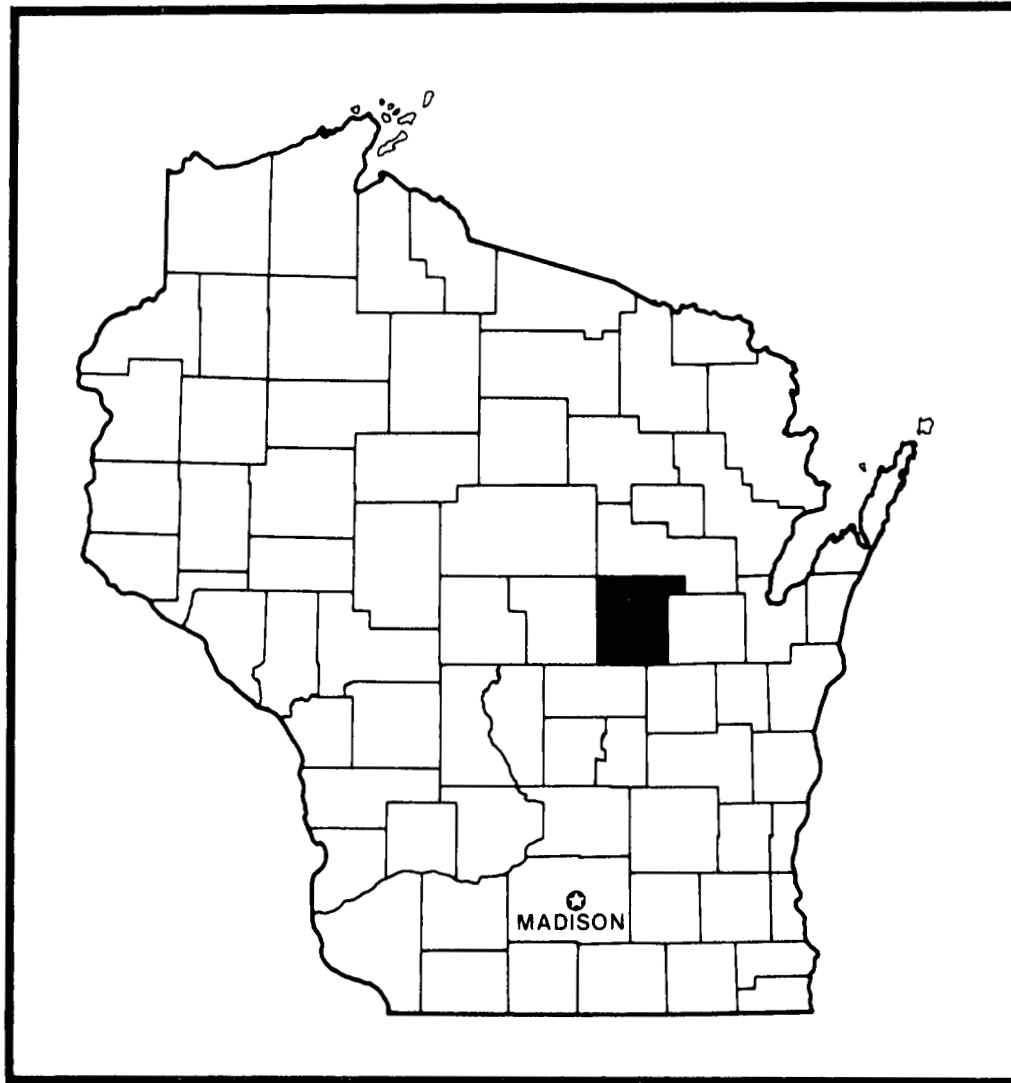
This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

A handwritten signature in black ink that reads "Clifton A. Maguire". The signature is fluid and cursive, with the first name "Clifton" being more prominent and the last name "Maguire" following in a similar style.

Clifton A. Maguire  
State Conservationist  
Soil Conservation Service



**Location of Waupaca County In Wisconsin.**

# Soil Survey of Waupaca County, Wisconsin

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By Augustine J. Otter, Soil Conservation Service

Fieldwork by John E. Campbell, Steven W. Frings, Augustine J. Otter,  
Fred J. Simeth, Duane T. Simonson, and Stephen C. Suhs,  
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service  
In cooperation with the Research Division of the  
College of Agricultural and Life Sciences, University of Wisconsin

WAUPACA COUNTY is in the east-central part of Wisconsin. It is bordered on the west by Portage County, on the east by Outagamie County, on the north by Shawano County, and on the south by Waushara County.

The county is about 30 miles east to west and 30 miles north to south at its widest points. It has a total area of 487,040 acres, or 761 square miles, including 9,640 acres of water. There are 6 cities, 6 villages, and 22 townships in the county.

The population of the county was 42,831 in 1980 (12). The city of Waupaca, in the southwestern part of the county, is the county seat. It is about 120 miles northwest of Milwaukee and 100 miles north of Madison.

About 85 percent of the county is farmland. Dairy farms are predominant. Corn, oats, and alfalfa are the principal crops.

Waupaca County is in the Northern Highland and Central Plain Geographical Provinces of Wisconsin (5). The soils are dominantly sandy and loamy and formed under forest vegetation. They generally have a light colored or a thin, dark surface layer. Erosion is the main management concern. Soils that have slope of more than 1 or 2 percent are subject to water erosion if they are not protected. Many of the soils that have slope of less than 2 percent are seasonally wet and need to be drained for dependable crop production.

## General Nature of the County

This section discusses climate; physiography, relief, and drainage; water supply; history and development; and transportation and industry.

## Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Winters in Waupaca County are very cold, and summers are short and fairly warm. The freeze-free period is short. Therefore, the choice of crops is limited mainly to forage, small grains, and adapted vegetables. Precipitation is fairly well distributed throughout the year, reaching a slight peak in summer. Snow generally covers the ground much of the time from late in fall through early in spring.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Waupaca, Wisconsin, in the period 1951 to 1979. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 19 degrees F, and the average daily minimum temperature is 9 degrees. The lowest temperature on record, which occurred at Waupaca on January 30, 1951, is -35 degrees. In summer the average temperature is 69 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on August 21, 1955, is 105 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 21 inches, or 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 4.36 inches at Waupaca on July 25, 1979. Thunderstorms occur on about 35 days each year, and most occur in summer.

The average seasonal snowfall is 48 inches. The greatest snow depth at any one time during the period of record was 33 inches. On an average, 59 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is 65 percent in summer and 45 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11 miles per hour, in spring.

Soils occasionally freeze to a depth of several feet when very cold weather occurs before the ground is appreciably covered with snow. Usually, the soil is frozen in only the top few inches or, at the most, to a depth of 12 inches, except where the snow cover has been removed.

## Physiography, Relief, and Drainage

In Waupaca County, about 79 percent of the area is uplands, 19 percent is wetlands, and 2 percent is water. The physiography of the county is the result of glacial activity. Kettle lakes formed on smooth outwash plains and on ground moraines. Large drumlins and moraines with steep sides are common throughout the county.

The highest elevation in the county is in the northwestern part, and the general slope is from this area to the south and east. The elevation of various cities and villages in the county is as follows: Iola, 930 feet; Waupaca, 870 feet; Manawa, 828 feet; Northport and Weyauwega, 779 feet; and New London, 767 feet.

Most of the county has a complex drainage pattern. Numerous areas of organic soils are scattered throughout the county; there are also a few lakes. Many of the organic areas are 60 feet below the surrounding uplands.

Waupaca County lies within the drainage basin of the Wolf River. Except for small, isolated depressions on the uplands, all parts of the county are reached by streams that provide outlets for drainage water. The Wolf River and its branches drain the north, east, and west. The Waupaca River drains the southern part of the county. Most of the streams have their start in wetlands or lakes that are fed by springs.

## Water Supply

The water table is within 50 feet of the surface throughout most of the county. Wells that are drilled through drumlins or moraines can tap into water at a depth of more than 50 feet but generally no deeper than 120 feet.

Ground water occurs under both water table and artesian conditions. Wolf River drains the ground water in the region.

An ample supply of ground water for irrigation is available at a relatively shallow depth in the southwestern part of the county. The recharge rate in that area is rapid. Generally, the depth of wells increases from the southwestern part of the county to the northwestern part. The supply of ground water is ample in the western part of the county, except where granitic bedrock is near the surface. Granitic bedrock is near the surface (3) in an area around Big Falls, an area that is locally known as Poppy's Rock, which is 3 miles south of New London, an area in the northern part of the city of Waupaca, and an area that is 4 miles north of Waupaca along the south branch of the Little Wolf River.

In the extreme southeastern part of the county near Readfield, wells have to be drilled through dolomite and into sandstone to reach a desirable source of water. The dolomite has a maximum thickness of 125 feet, but it is generally 30 to 60 feet thick.

In the central part of the county the water recharge rate is slow. The yield from wells in that area is unpredictable.

In the eastern part of the county there are artesian and water table wells. The recharge rate of the water-table wells is variable. Water yields range from less than 5 gallons per minute to as much as 425 gallons per minute. Some wells in this area have a musty or sulfurous odor, which is caused by contact of the ground water with an organic material, such as muck.

Most streams and lakes in the county are essentially exposed ground water. There are many miles of clean-water streams, lakes, and rivers in the county. There are 35 registered trout streams, which is an indication of the quality of the water. Kettle lakes are common in the western part of the county, but the greatest concentration of these lakes is in the southwestern part. A chain of 22 deep kettle lakes there is known as Chain O'Lakes. The lakes are used for recreation.

## History and Development

The Menominee Indians lived in the area that is now Waupaca County for many years before the arrival of French explorers, missionaries, and fur traders. It was nearly 200 years after the French exploration of the area that the first permanent settlement was established (13).

Sawmills began to appear in the area in about 1843. Towns and villages formed around the sawmills, and

Waupaca County became a center for the lumber industry. Pine was floated down the Wolf River to sawmills in New London, which was then the hub of the lumber industry. New London became one of the most prosperous towns in east-central Wisconsin.

In the early 1870's the lumber industry began to decline and agriculture started to flourish. Grist mills replaced sawmills; and cheese, butter, wheat, and potatoes became the principal products. Wheat and potato production peaked and declined in the 1880's. Dairy farming increased, and hay, small grains, and corn became the important crops. Today, farming is still an important source of revenue in the county; however, recreation and industry are gaining in importance.

The population of Waupaca County increased very little from the turn of the century to about 1970. During that period, rural population losses were about the same as population gains in the cities. Considerable growth has taken place since 1970. The population density is now about 50 people per square mile, which is above the average density in a typical agricultural county. The increase reflects the industrial development that has provided a substantial supplement to the agrarian economy.

## Transportation and Industry

Waterways, mainly the Wolf River and its tributaries, were the first means of commercial transportation in Waupaca County. The first railroad, the Green Bay Road, reached New London in 1871. Since then, additional railroads and many miles of highways have been added.

Waupaca County is now served by three railroads. These railroad lines cross the county in an east to west direction.

Waupaca County's well-developed network of highways consists of two federal highways and six state highways. The county is served by five common carrier trucklines. Commercial bus service is available throughout the county. Regular commercial air service is not available in the county.

The lumber industry at one time employed nearly 100 percent of the population of Waupaca County. As the industry declined, employment in the industry dropped to less than 5 percent of the population. This 5 percent mainly provided services to the farming community.

New and varied types of industry have come into the county and now account for about 60 percent of the net income in the county. These new industries include food processing and truck building plants. Manufacturing is the major economic activity in Waupaca County. Most of the manufacturing plants are small and employ less than 100 employees. More than one-third of the Waupaca County farmers supplement their income by working in the varied industries and manufacturing plants.

## How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

This soil survey of Waupaca County supercedes the soil survey of the county that was published in 1920 (8). This survey provides additional information and has larger maps that show the soils in greater detail.

## Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is

identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

# General Soil Map Units

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The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

## Soil Descriptions

### 1. Plainfield-Richford-Kranski

*Nearly level to steep, excessively drained to moderately well drained sandy soils; on uplands and stream terraces*

This map unit is characterized by broad outwash plains interspersed with drumlins and moraines. The soils are nearly level to sloping in most areas. They are moderately steep and steep on the side slopes of the drumlins and moraines and along the borders of some depressions and lakes.

This map unit makes up about 17 percent of the county. It is about 40 percent Plainfield soils, 15 percent Richford soils, 5 percent Kranski soils, and 40 percent soils of minor extent.

The Plainfield soils are nearly level to steep. They are dominantly excessively drained; in some areas they are moderately well drained. Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is brown and strong brown sand about 17 inches thick. It is very friable in the upper part and loose in the lower part. The substratum to a depth of about 60 inches is yellowish brown and brownish yellow, loose sand.

The Richford soils are nearly level to sloping and are somewhat excessively drained. They are intermingled with the Plainfield soils. Typically, the surface layer is dark brown loamy sand about 7 inches thick. The

subsurface layer is brown loamy sand about 14 inches thick. The subsoil is about 17 inches thick. It is brown, very friable sandy loam in the upper part and brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand.

The Kranski soils are gently sloping to moderately steep and are somewhat excessively drained. Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsoil is very friable loamy sand about 26 inches thick. It is dark brown in the upper part and reddish brown in the lower part. The substratum to a depth of about 60 inches is dark brown, very friable loamy sand.

The minor soils are the Kennan, Meehan, and Roscommon soils. The Kennan soils are well drained. They are on convex ridgetops and side slopes and are intermingled with the Kranski soils. The Meehan soils are somewhat poorly drained. They are in drainageways and in depressions. The Roscommon soils are poorly drained. They also are in drainageways and in depressions.

Most of the nearly level, gently sloping, and sloping soils in this map unit are used for cultivated crops, such as corn, oats, and alfalfa. Most of the moderately steep and steep soils are used as woodland, pasture, or habitat for wildlife. Many of the larger areas of nearly level and gently sloping soils are used for irrigated specialty crops, such as potatoes and snapbeans. Some of the sloping and moderately steep soils are used for Christmas trees. The main concerns in management are controlling soil blowing and erosion, overcoming the low available water capacity, and maintaining fertility.

The major soils in this map unit can readily absorb the effluent in septic tank absorption fields but can not adequately filter it. The poor filtering capacity can result in pollution of ground water. The major soils on slopes of less than 6 percent are suited to dwellings. Slopes of more than 6 percent limit the use of the soils for septic tank absorption fields and dwellings.

### 2. Kennan-Rosholt

*Nearly level to steep, well drained loamy soils; on uplands and stream terraces*

This map unit consists mostly of soils on drumlins, outwash plains, and stream terraces. The drumlins are

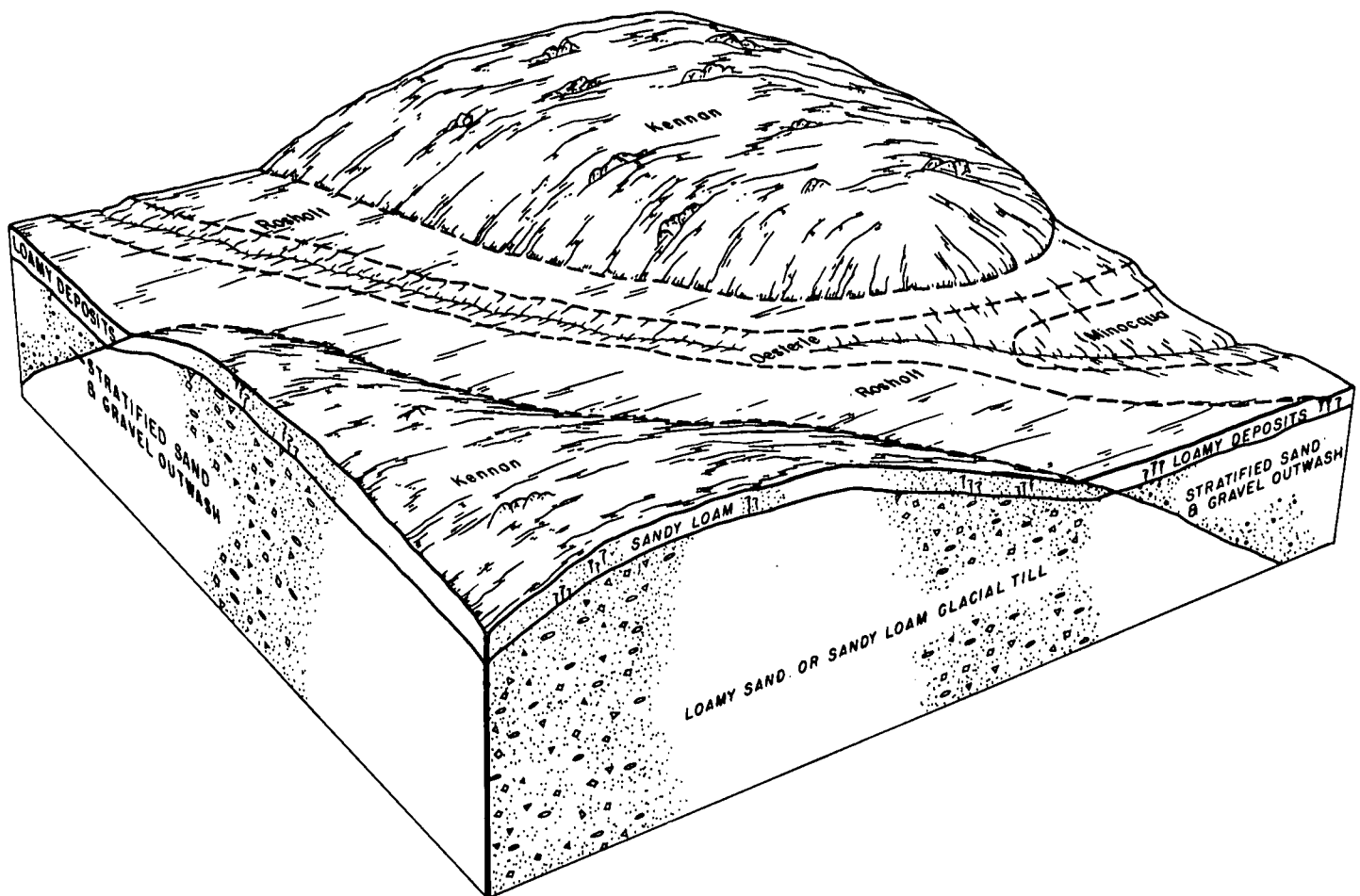


Figure 1.—Topography, underlying material, and pattern of the soils in the Kennan-Rosholt map unit.

oriented in an east-west direction. The soils are nearly level to sloping in most areas. They are moderately steep and steep on the side slopes of some of the drumlins.

This map unit makes up about 33 percent of the county. It is about 40 percent Kennan soils, 20 percent Rosholt soils, and 40 percent soils of minor extent (fig. 1).

The Kennan soils are gently sloping to steep. They are well drained. Typically, the surface layer is very dark gray bouldery sandy loam about 2 inches thick. The subsurface layer is mostly brown sandy loam about 19 inches thick. The subsoil to a depth of about 60 inches is mostly brown, friable sandy loam.

The Rosholt soils are nearly level to moderately steep. They are well drained. Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsurface layer is mostly brown sandy loam about 11

inches thick. The subsoil is about 17 inches thick. It is dark brown, friable loam in the upper part; dark brown, friable sandy loam in the middle part; and brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, loose, stratified sand and gravel.

The minor soils are the Elderon, Minocqua, and Oesterle soils. The Elderon soils are somewhat excessively drained. They are on choppy side slopes on knolls and ridges. The Minocqua soils are poorly drained. They are in drainageways and in depressions. The Oesterle soils are somewhat poorly drained. They are in drainageways.

Most of the nearly level to sloping soils in this map unit are used for cultivated crops, such as corn, oats, and alfalfa. In some areas, the nearly level and gently sloping Rosholt soils are used for irrigated specialty crops, such as potatoes. The steeper soils are used as

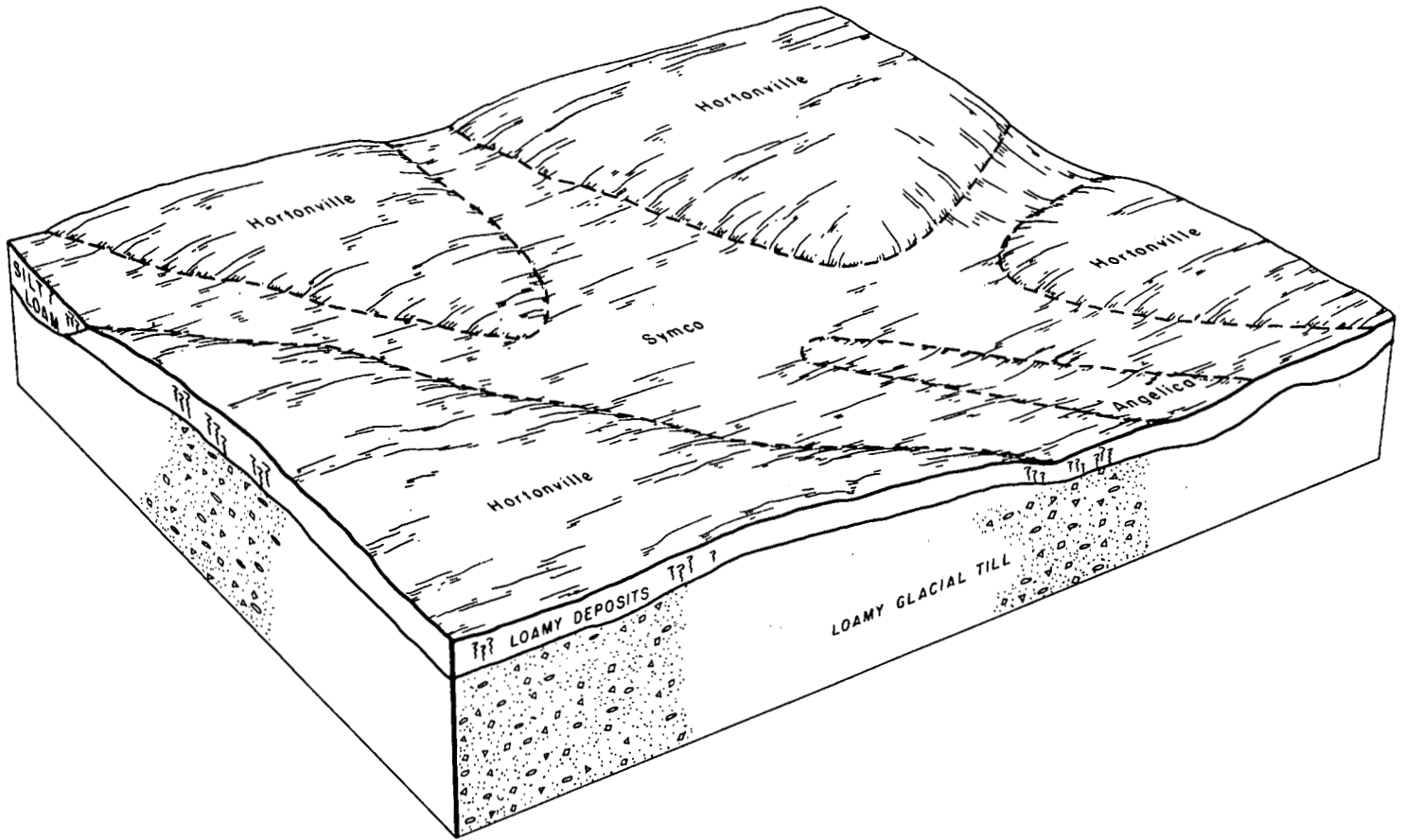


Figure 2.—Topography, underlying material, and pattern of the soils in the Hortonville-Symco map unit.

woodland, pasture, or habitat for wildlife. The main concerns in management are controlling erosion and soil blowing and maintaining fertility.

The Kennan soils that have slopes of less than 6 percent are moderately suited to septic tank absorption fields. Large stones can hinder construction. The Rosholt soils can readily absorb the effluent in a septic tank absorption field but can not adequately filter it. The poor filtering capacity can result in the pollution of ground water. Slopes of more than 6 percent limit the use of the Kennan and Rosholt soils for septic tank absorption fields and dwellings.

### 3. Hortonville-Symco

*Nearly level to moderately steep, well drained and somewhat poorly drained loamy soils; on uplands*

This map unit consists mostly of soils on low drumlins and ground moraines that are dissected by drainageways. The soils are nearly level to sloping in most areas. They are moderately steep on the side slopes of some drumlins.

This map unit makes up about 30 percent of the county. It is about 40 percent Hortonville soils, 20 percent Symco soils, and 40 percent soils of minor extent (fig. 2).

The Hortonville soils are gently sloping to moderately steep. They are well drained. Typically, the surface layer is dark grayish brown fine sandy loam about 9 inches thick. The subsoil is about 19 inches thick. It is mostly dark brown, firm sandy clay loam in the upper part; reddish brown, firm clay loam in the middle part; and reddish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, calcareous fine sandy loam.

The Symco soils are nearly level and gently sloping. They are somewhat poorly drained. Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 18 inches thick. It is dark brown, mottled, firm clay loam in the upper part and reddish brown, mottled, firm clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, friable, calcareous clay loam.

The minor soils are the Angelica, Plainfield, Tilleda, and Whalan soils. The Angelica soils are poorly drained. They are in depressions and in drainageways. The Plainfield soils are excessively drained. They are on convex ridgetops and side slopes. The Tilleda soils are well drained. They are on convex side slopes and ridgetops on the western edge of the map unit. The Whalan soils are well drained. They are on convex side slopes and ridgetops in the southeastern part of the county. Dolomite bedrock is within a depth of 40 inches in this area.

The major soils are used mainly for cultivated crops, such as corn, oats, and alfalfa. Some of the moderately steep soils are used as woodland, pasture, or habitat for wildlife. The main concerns in management on the well drained soils are controlling erosion and maintaining fertility. On the somewhat poorly drained soils, the main concerns are adequately draining the soils and maintaining fertility.

Where the slope is less than 6 percent, Hortonville soils are moderately suited to use as septic tank absorption fields because of the moderate permeability and are moderately suited to use as sites for dwellings because of the moderate shrink-swell potential. Slope, where it is more than 6 percent, is a limitation on the Hortonville soils for septic tank absorption fields and dwellings. Symco soils are poorly suited to use as septic tank absorption fields and as sites for dwellings because of wetness and moderately slow permeability.

#### 4. Borth-Poy

*Nearly level and gently sloping, moderately well drained and poorly drained silty and loamy soils; in glacial lake basins*

This map unit is characterized by broad glacial lake basins interspersed with knolls and ridges.

This map unit makes up about 4 percent of the county. It is about 35 percent Borth soils, 15 percent Poy soils, and 50 percent soils of minor extent.

The Borth soils are nearly level and gently sloping. They are moderately well drained. Typically, the surface layer is dark brown silty clay loam about 9 inches thick. The subsoil is reddish brown, firm clay about 15 inches thick. The lower part of the subsoil is mottled. The substratum to a depth of 60 inches is strong brown, light brownish gray, and dark reddish brown, mottled, loose sand.

The Poy soils are nearly level. They are poorly drained. Typically, the surface layer is very dark gray clay loam about 10 inches thick. The subsoil is dark gray and gray, mottled, firm clay about 17 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, loose sand.

The minor soils are the Nebago, Shawano, and Tustin soils. The Nebago soils are somewhat poorly drained. They are in drainageways and in shallow swales. The Shawano soils are excessively drained. They are on

convex ridgetops and side slopes. The Tustin soils are well drained. They are on low knolls and ridges.

The major soils are used mainly for cultivated crops, such as corn, oats, alfalfa. The soils in some undrained depressions are used as woodland, pasture, or habitat for wildlife. The main concerns in management are controlling erosion, lowering the water table by artificial drainage, and maintaining good tilth and fertility (fig. 3).

The soils are poorly suited to use as septic tank absorption fields because of wetness, the moderately slow to very slow permeability in the subsoil, and the rapid permeability in the substratum. The soils are poorly suited to use as sites for dwellings because of wetness or ponding. The high shrink-swell potential is a limitation for dwellings with basements.

#### 5. Waupaca-Wega-Zurich

*Nearly level and gently sloping, moderately well drained to poorly drained silty soils; in glacial lake basins*

This map unit is characterized by broad basins interspersed with some knolls and ridges.

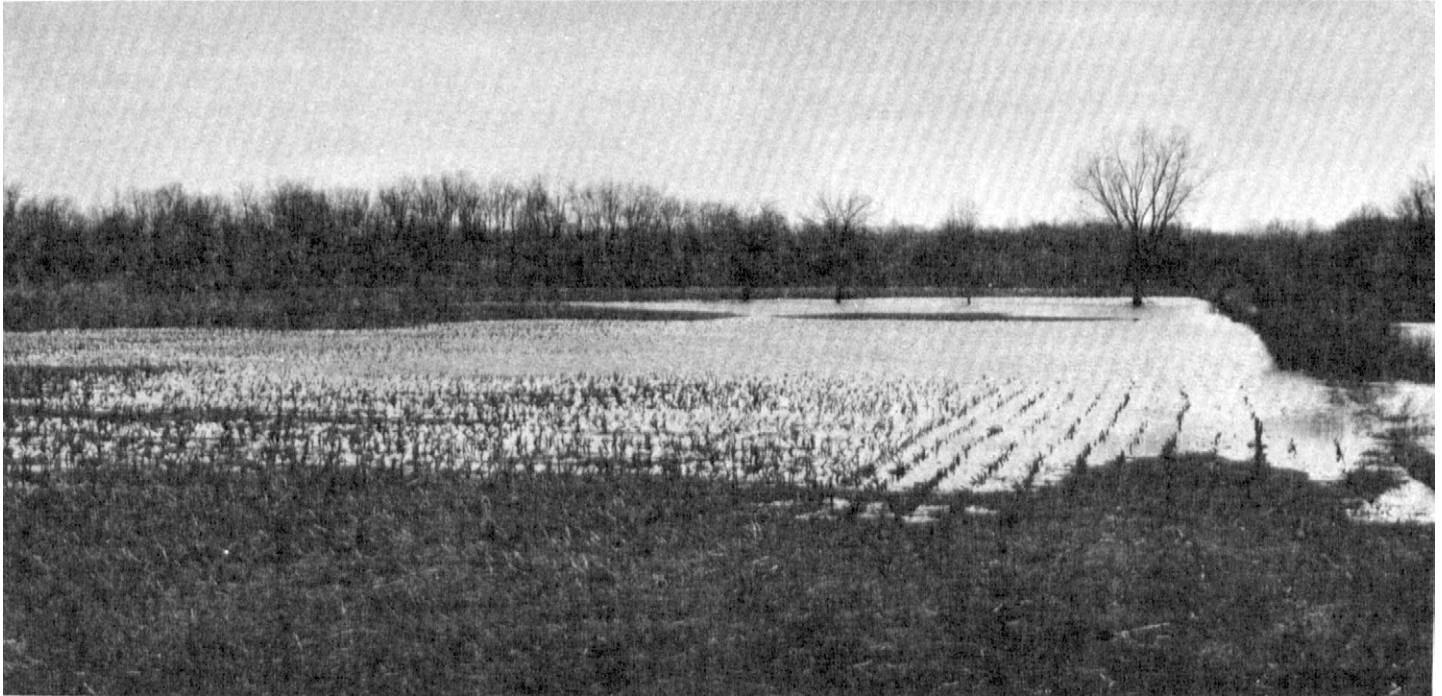
This map unit makes up about 5 percent of the county. It is about 20 percent Waupaca soils, 20 percent Wega soils, 5 percent Zurich soils, and 55 percent soils of minor extent.

The Waupaca soils are nearly level. They are poorly drained. Typically, the surface layer is very dark brown silt loam about 9 inches thick. The substratum to a depth of about 60 inches is multicolored, very friable, stratified, calcareous silt and very fine sand.

The Wega soils are nearly level and gently sloping. They are somewhat poorly drained. Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The substratum to a depth of about 60 inches is brown and strong brown, mottled, friable silt loam in the upper part and light brown and reddish yellow, mottled, very friable, stratified silt and silt loam in the lower part.

The Zurich soils are gently sloping. They are moderately well drained. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is mostly dark brown, friable silt loam about 13 inches thick. The substratum to a depth of about 60 inches is brown, brownish yellow, and dark brown, mottled, very friable, stratified silt loam and very fine sandy loam.

The minor soils are the Nebago, Roscommon, Shawano, and Tustin soils. The Nebago soils are somewhat poorly drained. They are in drainageways and are intermingled with the Wega soils. The Roscommon soils are poorly drained. They are in depressions and in drainageways and are intermingled with the Waupaca soils. The Shawano soils are excessively drained. They are on convex ridgetops and knolls and on side slopes of ridges, knolls, and hills. The Tustin soils are well drained. They are on low knolls and ridges that have clayey deposits within a depth of 40 inches.



**Figure 3.—The soils in the Borth-Poy map unit are used mainly for cultivated crops but need artificial drainage. Borth soils surround the ponded area of Poy soils.**

The major soils are used mainly for cultivated crops, such as corn, oats, and alfalfa. The soils in some undrained depressions are used as habitat for wildlife or as woodland. The main concerns in management are controlling erosion on the gently sloping soils, lowering the water table on the nearly level soils, and maintaining fertility.

The Waupaca and Wega soils are poorly suited to use as septic tank absorption fields and as sites for dwellings because of wetness, ponding, and moderately slow permeability. The Zurich soils are moderately suited to use as septic tank absorption fields because of wetness and moderate permeability. They are moderately suited to use as sites for dwellings with basements because of wetness and as sites for dwellings without basements because of the moderate shrink-swell potential of the subsoil.

## **6. Cathro-Markey-Seelyeville**

*Nearly level, very poorly drained mucky soils; in upland depressions and on flood plains*

This map unit consists of soils on flood plains and in depressions.

This map unit makes up about 11 percent of the county. It is about 25 percent Cathro soils, 25 percent

Markey soils, 20 percent Seelyeville soils, and 30 percent soils of minor extent.

The Cathro soils are nearly level. They are very poorly drained. Typically, the surface layer is black muck about 40 inches thick. The substratum to a depth of about 60 inches is gray, friable loam.

The Markey soils are nearly level. They are very poorly drained. Typically, the surface layer is black muck about 21 inches thick. The substratum to a depth of about 60 inches is brown, loose sand.

The Seelyeville soils are nearly level. They are very poorly drained. Typically, this soil is black muck about 60 inches thick.

The minor soils are the Angelica, Fordum, Loxley, and Roscommon soils. The Angelica and Roscommon soils are poorly drained. They are in depressions and in drainageways. The Forum soils are poorly drained or very poorly drained. They are on flood plains. The soils formed in loamy deposits. The Loxley soils are very poorly drained. They are in depressions. They have a surface layer of sphagnum moss.

The major soils are used mainly as habitat for wildlife and as woodland. They are poorly suited to agricultural crops because killing frosts are a hazard.

The soils generally are not suitable as sites for septic tank absorption fields and dwellings mainly because of ponding or flooding.



## Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Hortonville fine sandy loam, 2 to 6 percent slopes, is one of several phases in the Hortonville series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Elderon-Rosholt complex, 6 to 12 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be

made up of all of them. Cathro and Markey mucks is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

### Soil Descriptions

**Ax—Angelica silt loam.** This is a nearly level, poorly drained soil in depressions and in drainageways. It is subject to ponding. Most areas of this soil are long and narrow and range from 5 to 60 acres in size.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsoil is about 17 inches thick. It is light brownish gray, mottled, friable loam in the upper part; brown, mottled, friable loam in the middle part; and reddish brown, mottled, friable loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, calcareous loam. In some places, the surface layer is muck or mucky silt loam. In some small areas, there are bands of silt and fine sand in the substratum below a depth of 40 inches.

Included in mapping are small areas of Cathro, Markey, and Symco soils. The Cathro and Markey soils are very poorly drained. They are in lower depressions than the Angelica soil. They formed in 16 to 51 inches of muck. The Symco soils are somewhat poorly drained. Like the Angelica soil, they are in slight depressions and drainageways, but they are higher on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Angelica soil is moderately slow, and the available water capacity is high. The organic matter content in the surface layer is moderate. Natural fertility is high. The surface layer and the subsoil are neutral or slightly acid. The substratum is mildly alkaline or moderately alkaline. The surface layer is friable, but wetness restricts tillage. Unless the soil is drained, the root development of many plants is limited because of ponding and the seasonal high water table or because of the density of the subsoil and substratum. The response to additions of plant nutrients is limited because of wetness and ponding.

In most areas, the soil is used as cropland. In some areas, it is used as pasture or woodland.

If it is drained and protected from runoff from higher adjacent soils, this Angelica soil is suited to corn for silage. Tile drains or open ditches can be used to lower the ground water. Diversions on the surrounding uplands reduce ponding. In some of the lower lying areas, the growing season is short because cold air drains into these areas. Alfalfa is subject to winterkill from frost heave and ice sheeting.

This soil is suited to pasture crops if it is drained and protected from ponding. Water-tolerant grasses, such as red canarygrass, grow best on this soil. Grazing when the surface layer is wet causes surface compaction which restricts plant growth. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the soil and the pasture plants in good condition.

This soil is suited to trees. Because of wetness and ponding, seedlings should be planted on prepared ridges if natural regeneration is unreliable. Planting vigorous nursery stock is essential to minimize seedling mortality. Harvesting generally is done only when the soil is frozen. Harvesting by clearcutting or by an area selection method reduces windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields or as sites for dwellings because of ponding and the moderately slow permeability of the soil. Because these limitations are difficult to overcome, the selection of a more favorable site should be considered.

This soil is poorly suited to use for local roads and streets because of ponding and the hazard of frost damage. Ponding can be controlled by installing culverts and side ditches to remove the surface water or by using fill material to raise the roadbed above the level of ponding. Culverts can prevent road damage. Frost damage can be prevented by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel.

This Angelica soil is in capability subclass 1lw, drained; and in woodland suitability subclass 3w.

#### **BoB—Borth sandy loam, 1 to 4 percent slopes.**

This is a nearly level to gently sloping, moderately well drained soil on low ridges and knolls. Most areas of this soil are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 9 inches thick. The subsoil is reddish brown, firm clay about 18 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, loose sand. In some places, the surface layer is loam or loamy sand. In some small areas, 3 to 5 inches of the original surface layer has eroded away.

Included in mapping are small areas of Oshkosh, Poy, and Tustin soils. Oshkosh and Tustin soils are well drained. They and the Borth soil are in similar positions on the landscape. Unlike the Borth soil, Oshkosh soils have a clay substratum. Tustin soils have a 20- to 36-inch sandy mantle. Poy soils are poorly drained. They are in depressions. The Poy soils and the Borth soil formed in similar deposits. Also included are small areas where the Borth soil does not have mottles and the seasonal high water table is at a depth of more than 6 feet. The included soils make up 5 to 10 percent of the map unit.

Permeability is slow or moderately slow in the subsoil of this Borth soil and rapid in the substratum. The available water capacity is low. The content of organic matter in the surface layer is moderate. Natural fertility is medium. The surface layer and subsoil are medium acid to moderately alkaline. The substratum is neutral or mildly alkaline. There are free carbonates in the lower part of the subsoil in some places. The surface layer is friable and is easily tilled within a wide range of moisture content. The shrink-swell potential in the subsoil is high. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as cropland. In some areas, it is used as woodland or pasture.

This Borth soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If the soil is cultivated, erosion is a slight or moderate hazard. Minimum tillage, winter cover crops, and grassed waterways reduce soil loss. This soil is suited to sprinkler irrigation, but the rate of application must be controlled to prevent runoff and erosion because the soil has a slow water intake rate.

The use of this soil as pasture is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction, which in turn reduces infiltration and increases runoff. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration

following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness, the slow or moderately slow permeability in the subsoil, and the poor filtering capacity of the substratum. These limitations can be overcome by constructing a filtering mound of suitable material.

The soil is poorly suited to use as sites for dwellings without basements because of the high shrink-swell potential in the subsoil. This problem can be prevented by covering or replacing the upper part of the soil with a coarse material, such as sand or gravel. This soil is poorly suited to use as sites for dwellings with basements because of wetness. This problem can be corrected by constructing the basement above the level of wetness or by installing tile drains around the foundation and providing gravity outlets or other dependable outlets.

This soil is poorly suited to local roads and streets because of low strength and the high shrink-swell potential in the subsoil. These limitations can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase material overcomes the low strength of the soil.

This Borth soil is in capability subclass 1Ie and in woodland suitability subclass 3c.

**BrB—Borth silty clay loam, 1 to 4 percent slopes.**

This is a nearly level to gently sloping, moderately well drained soil on low ridges and knolls. Most areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark brown silty clay loam about 9 inches thick. The subsoil is reddish brown, firm clay about 15 inches thick. The lower part of the subsoil is mottled. The substratum to a depth of about 60 inches is strong brown, light brownish gray, and dark reddish brown, loose sand. The lower part of the substratum is mottled. In some places, the surface layer is sandy loam, silt loam, or silty clay. In some small areas, 3 to 5 inches of the original surface layer has been lost through erosion.

Included in mapping are small areas of Oshkosh, Poy, and Tustin soils. Oshkosh and Tustin soils are well drained. They and the Borth soil are in similar positions on the landscape. Unlike the Borth soil, Oshkosh soils have a clay substratum, and Tustin soils have a 20- to 36-inch sandy mantle. Poy soils and the Borth soil formed in similar deposits. Poy soils are poorly drained and are in depressions. In some small areas, the Borth soil does not have mottles and the seasonal high water table is at a depth of more than 6 feet. In some small areas, the substratum has silt and very fine sand below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability is slow or moderately slow in the subsoil and rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is moderate. Natural fertility is medium. The surface layer and subsoil are medium acid to moderately alkaline. The substratum is neutral to mildly alkaline. There are free carbonates in the lower part of the subsoil in some places. The surface layer is clayey enough that clods form if the soil is tilled when too moist. The shrink-swell potential is high in the subsoil. The response to additions of plant nutrients is limited because of the low available water capacity and poor tilth.

In most areas, this soil is used as cropland. In some areas, it is used as woodland or pasture.

This Borth soil is suited to corn and small grains and to grasses. Crop yields in most seasons are limited because of the low available water capacity. The soil is subject to crusting, which results in poor emergence of small seeded crops. If this soil is cultivated, erosion is a slight or moderate hazard. Minimum tillage, winter cover crops, and grassed waterways reduce soil loss. Maintaining the content of organic matter helps reduce erosion, increases the water infiltration rate, and reduces crusting. Returning crop residue to the soil or adding other organic material improves fertility and tilth. This soil is suited to sprinkler irrigation, but the rate of application must be controlled to prevent runoff and erosion because the soil has a slow water intake rate.

The use of this soil as pasture is effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction, which reduces infiltration and increases runoff. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the soil and the pasture plants in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness, the slow or moderately slow permeability in the subsoil, and the poor filtering capacity of the substratum. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings without basements because of the high shrink-swell potential in the subsoil. This problem can be prevented by covering or replacing the upper part of the soil with a coarse material, such as sand or gravel. This soil is poorly suited to use as sites for dwellings with basements because of wetness. This problem can be corrected by constructing the basement above the level of wetness or by installing tile drains around the foundation. A gravity outlet or other dependable outlet is needed.

This soil is poorly suited to use for local roads and streets because of low strength and the high shrink-swell potential in the subsoil. These limitations can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase material also overcome the low strength of the soil.

This Borth soil is in capability subclass 1Ie and in woodland suitability subclass 3c.

**BxA—Borth-Nebago-Meehan complex, 0 to 3 percent slopes.** This complex consists of nearly level and gently sloping, moderately well drained and somewhat poorly drained soils on low ridges and knolls and in drainageways and shallow swales. Most areas are irregular in shape and range from 10 to 80 acres in size.

The Borth soil is moderately well drained and is on low ridges and knolls. It makes up 25 to 35 percent of the complex. The Nebago and Meehan soils are somewhat poorly drained. They are in drainageways and in shallow swales. The Nebago soil makes up 20 to 30 percent of the complex, and the Meehan soil makes up 15 to 25 percent. The areas of these soils are so intricately mixed or so small that it was not practical to map them separately.

Typically, the Borth soil has a surface layer of dark brown silty clay loam about 9 inches thick. The subsoil is reddish brown, firm clay about 15 inches thick. The lower part of the subsoil is mottled. The substratum to a depth of about 60 inches is strong brown, light brownish gray, and dark reddish brown, mottled, loose sand. In some places the surface layer is sandy loam.

Typically, the Nebago soil has a surface layer of very dark gray loamy sand about 9 inches thick. The subsurface layer is light brownish gray loamy sand about 4 inches thick. The subsoil is about 35 inches thick. It is dark brown, loose sand in the upper part; dark yellowish brown, mottled, loose sand in the middle part; and reddish brown, mottled, firm silty clay in the lower part. The substratum is reddish brown, mottled, firm silty clay in the upper 6 inches. Below that, to a depth of about 60 inches or more, it is pale brown, mottled, loose sand.

Typically, the Meehan soil has a surface layer of very dark grayish brown loamy sand about 9 inches thick. The subsoil is about 17 inches thick. It is brown, mottled, very friable loamy sand in the upper part and brown and yellowish brown, mottled, loose sand in the lower part. The substratum to a depth of about 60 inches is light brown, mottled, loose sand.

Included in mapping are small areas of the Neenah, Poy, Roscommon, and Shawano soils. Neenah soils and the soils making up this complex are in similar positions on the landscape. Neenah soils are somewhat poorly drained and are clayey throughout. Poy soils are in lower positions. They are poorly drained and formed in 20 to 40 inches of loamy and clayey deposits underlain by

sand. Roscommon soils are in depressions and broad drainageways. They are poorly drained and are sandy throughout. Shawano soils are in higher positions on the landscape. They are excessively drained and are sandy throughout. In some areas, the slope is more than 3 percent. The included soils make up 20 to 30 percent of the map unit.

Permeability is slow or moderately slow in the subsoil of the Borth soil and rapid in the substratum. Permeability is rapid in the subsurface layer of the Nebago soil, moderately slow or slow in the subsoil and upper part of the substratum, and rapid in the lower part of the substratum. Permeability is rapid in the Meehan soil. The available water capacity of these soils is low. The content of organic matter in the surface layer of the Borth soil is moderate and moderately low in the surface layer of the Nebago and Meehan soils. Natural fertility is medium in the Borth soil and low in the Nebago and Meehan soils. The soils are strongly acid to mildly alkaline. The surface layer of the Nebago and Meehan soils is friable and is easily tilled. The Borth soil has a clayey surface layer; clods form if the soil is tilled when too moist. The shrink-swell potential is high in the subsoil of the Borth soil and high in the subsoil and upper part of the substratum of the Nebago soil.

In most areas, these soils are used as cropland. Some areas are used as pasture or woodland.

The major soils are suited to corn and small grains and to grasses and legumes for hay. The Meehan and Nebago soils need drainage for best crop production. If tile drainage is used, sand enters the tile lines unless a suitable filter is used to cover the tile. On the Meehan and Nebago soils, alfalfa is subject to winterkill from frost heave. Returning crop residue to the soil or regularly adding other organic material improves fertility, tilth, and water infiltration.

The soils are moderately suited to pasture. Overgrazing or grazing when the soils are wet results in soil compaction and causes damage to the vegetative cover. Fertilization, renovation, controlled grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

These soils are suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

The Borth, Nebago, and Meehan soils are poorly suited to use as septic tank absorption fields because of wetness, the moderately slow or slow permeability, and the poor filtering capacity of the soils. These limitations can be overcome by constructing a filtering mound of suitable material.

The soils are poorly suited to use as sites for dwellings without basements because of the high shrink-swell potential of the Borth soil and the wetness of the Meehan and Nebago soils. The problem of shrinking and

swelling of the soil can be prevented by covering or replacing the upper part of the soil with a coarse material, such as sand or gravel. The problem of wetness can be corrected by raising the site using fill material or by installing tile drains around the foundation and providing gravity outlets or other dependable outlets.

The soils are poorly suited to dwellings with basements because of wetness. The high shrink-swell potential in the silty clay layers of the Nebago soil also is a limitation for this use. The problem of wetness can be corrected by constructing the basement above the level of wetness or by installing tile drains around the foundation. A gravity outlet or other dependable outlet is needed. The problem of shrinking and swelling can be prevented by using a coarse fill, such as sand or gravel, under the foundation and by backfilling around the foundation with a similar coarse material.

The Borth soil is poorly suited to local roads and streets because of low strength and the high shrink-swell potential in the subsoil. These limitations can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. The Meehan and Nebago soils are moderately suited to local roads and streets because of wetness and the hazard of frost damage. These problems can be overcome by installing an open ditch or subsurface drainage system to lower the seasonal high water table and by using coarse fill, such as sand or gravel, to raise the roadbed above the level of wetness.

This complex is in capability subclass 1Ie. The Borth soil is in woodland suitability subclass 3c, the Nebago soil is in 2s, and the Meehan soil is in 3w.

**Cm—Cathro and Markey mucks.** These soils are nearly level and are very poorly drained. They are in depressions and on flood plains. They are subject to frequent, long periods of flooding and ponding. Most areas are elongated or irregular in shape and range from 5 to 80 acres in size. The Cathro and Markey soils are so similar in morphology and behavior characteristics that it was not practical to map them separately. Each mapped area consists of one or both of these soils in varying proportions.

Typically, the Cathro soil has a black muck layer about 40 inches thick. The substratum to a depth of about 60 inches is gray, friable loam. In some places, the muck layer is more than 51 inches thick.

Typically, the Markey soil has a black muck layer about 21 inches thick. The substratum to a depth of about 60 inches is brown, loose sand.

Included in mapping are small areas of the Angelica and Roscommon soils. These soils are in slightly higher positions on the landscape than the Cathro and Markey soils. They are poorly drained. Angelica soils are loamy. Roscommon soils are sandy throughout. In some small areas, the soils are covered with water most of the year.

The included soils make up 5 to 10 percent of the map unit.

Permeability is moderately rapid in the organic layer of the Cathro soil and moderate or moderately slow in the substratum. Permeability is moderately rapid in the Markey soil. The available water capacity of these soils is very high. The organic layer is very high in content of organic matter. Natural fertility is low. The Cathro soil is medium acid to neutral in the organic layer and slightly acid to mildly alkaline in the substratum. The Markey soil is slightly acid to mildly alkaline in the organic layer and the substratum. The organic layer of the Cathro and Markey soil is friable. Wetness and low soil strength limit the use of common farm equipment on these soils. Unless the soils are drained, root development of most plants is limited because of the seasonal high water table. The response to additions of plant nutrients is limited because of wetness.

In most areas, these soils are in native vegetation consisting of water-tolerant trees, marsh grasses, cattails, sedges, reeds, redosier, and alder. In a few areas, the soils are drained and are used for corn for silage.

The Cathro and Markey soils generally are not suited to use as cropland. The hazard of flooding and ponding and a short growing season that is caused by cold air drainage limit crop yields and restrict the crops that can be grown on the soils. In undrained areas, the only crop that can grow is marsh hay, which can be harvested in dry periods.

These soils generally are not suited to use as pasture. Organic soils are easily cut by the hooves of cattle; therefore, grazing is restricted to dry periods.

These soils are suited to trees. Wetness and the high water table during the planting season limit reforestation to natural regeneration. In harvesting, heavy equipment can be used only when the soil is frozen. Harvesting can be done by clearcutting or by an area-selection method that helps reduce windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

These soils generally are not suited to use as septic tank absorption fields or as sites for dwellings or for local roads and streets. The main limitations are flooding, ponding, and the hazards of frost damage. Because these limitations are difficult to overcome, the selection of a more favorable site should be considered.

These soils are in capability subclass VIIw, undrained, and in woodland suitability subclass 3w.

**EcC—Elderon-Rosholt complex, 6 to 12 percent slopes.** This complex consists of sloping, somewhat excessively drained and well drained soils on short, choppy side slopes and on ridgetops. Most areas are irregular in shape and range from 10 to 40 acres in size.

The Elderon soil is somewhat excessively drained. It makes up 40 to 50 percent of the complex. The Rosholt soil is well drained. It makes up 35 to 45 percent of the complex. The areas of these soils are so intricately mixed and so small that it was not practical to map them separately.

Typically, the Elderon soil has about 2 inches of partly decomposed leaves and twigs on the surface. The surface layer is brown stony loamy coarse sand about 6 inches thick. The subsoil is brown, very friable, very gravelly loamy coarse sand about 43 inches thick. The substratum to a depth of about 60 inches is strong brown, loose very gravelly coarse sand.

Typically, the surface layer of the Rosholt soil is black sandy loam about 2 inches thick. The subsurface layer is grayish brown sandy loam about 7 inches thick. The subsoil is about 25 inches thick. It is mostly dark yellowish brown, very friable gravelly sandy loam in the upper part; brown, friable gravelly sandy loam in the middle part; and brown, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose sand and gravel.

Included in mapping are small areas of the Kennan and Plainfield soils. These soils and the soils making up this complex are in similar positions on the landscape. The Kennan soils are bouldery and are well drained. They have more clay and less sand and gravel in the substratum than the soils that make up this complex. The Plainfield soils are excessively drained. They have fewer coarse fragments in the substratum. In some small areas, the slope is more than 12 percent. Also included in mapping are some small areas of wet soils in depressions. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the subsoil of the Elderon soil and very rapid in the substratum. Permeability is moderately rapid in the subsoil of the Rosholt soil and very rapid in the substratum. The available water capacity is very low in the Elderon soil. It is low in the Rosholt soil. The organic matter content is low in the surface layer of the Elderon soil. It is moderately low in the surface layer of the Rosholt soil. Natural fertility is low in these soils. The Elderon soil is neutral to strongly acid. The Rosholt soil is slightly acid to strongly acid. The response to additions of plant nutrients is limited because of the low and very low available water capacity.

In most areas, the soils are used as woodland. In some areas, they are used as pasture.

The soils are poorly suited to use as cropland because of the gravel, cobbles, and stones on the surface of the Elderon soil.

These soils are suited to use as pasture. Yields in most seasons are limited because of the very low and low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. The preparation of a seedbed is difficult because of rock

fragments. Fertilization, renovation, and rotation grazing help to keep the pasture plants and the soil in good condition.

The Elderon and Rosholt soils are suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. Competing vegetation can be controlled by herbicides or by mechanical removal. Cobbles and stones on the surface, which are common on the Elderon soil, hinder the use of machinery for planting and harvest.

These soils can readily absorb the effluent in a septic tank absorption field but can not adequately filter it. The poor filtering capacity can result in the pollution of ground water.

The Rosholt soil is moderately suited to use as sites for dwellings with or without basements because of slope. The Elderon soil is moderately suited to use as sites for dwellings because of slope and large stones on the soil. The limitation of slope can be overcome by cutting and filling to reduce the slope and also by constructing dwellings to conform to the existing slope. Stones can be removed by mechanical means. These soils are moderately suited to local roads and streets because of large stones on the Elderon soil and the hazard of frost damage on the Rosholt soil. Slope is a limitation on both soils. It can be overcome by cutting and filling to shape the roadway. Frost damage can be prevented by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. The problem of stones can be corrected by raising the roadbed above the stones or by mechanically removing them.

This complex is in capability subclass VI<sub>s</sub>. The Elderon soil is in woodland suitability subclass 3x, and the Rosholt soil is in 2o.

**EcD—Elderon-Rosholt complex, 12 to 30 percent slopes.** This complex consists of moderately steep and steep, somewhat excessively drained and well drained soils on short, choppy side slopes and on the tops of ridges and hills. Most areas are irregular in shape and range from 10 to 80 acres in size.

The Elderon soil is somewhat excessively drained. It makes up 55 to 65 percent of the complex. The Rosholt soil is well drained. It makes up 20 to 30 percent. The areas of these soils are so intricately mixed and so small that it was not practical to map them separately.

Typically, the Elderon soil has about 2 inches of partly decomposed leaves and twigs on the surface. The surface layer is brown stony loamy coarse sand about 4 inches thick. The subsoil is brown, very friable, very gravelly loamy coarse sand about 22 inches thick. The substratum to a depth of about 60 inches is light brown, loose very gravelly coarse sand.

Typically, the surface layer of the Rosholt soil is black sandy loam about 3 inches thick. The subsurface layer is

grayish brown sandy loam about 9 inches thick. The subsoil is about 20 inches thick. It is mostly yellowish brown, very friable gravelly sandy loam in the upper part; brown, friable gravelly sandy loam in the middle part; and brown, very friable gravelly loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose sand and gravel.

Included in mapping are small areas of the Kennan and Plainfield soils. The included soils and the soils making up this complex are in similar positions on the landscape. The Kennan soils are bouldery and are well drained. They have more clay and less sand and gravel in the substratum. The Plainfield soils have fewer coarse fragments in the substratum. In some small areas, the slope is less than 12 percent. Also included in mapping are some small areas of soils in wet depressions. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the subsoil of the Elderon soil and very rapid in the substratum. Permeability is moderately rapid in the subsoil of the Rosholt soil and very rapid in the substratum. The available water capacity of the Elderon soil is very low, and that of the Rosholt soil is low. The organic matter content in the surface layer of the soils is low or moderately low. Natural fertility is low. The Elderon soil is neutral to strongly acid, and the Rosholt soil is slightly acid to strongly acid. The response to additions of plant nutrients is limited by low and very low available water capacity.

In most areas, the soils are used as woodland. They generally are not suited to use as cropland because of slope and because of the gravel, cobbles, and stones on the surface of the Elderon soil.

The soils are poorly suited to use as pasture. Yields in most seasons are limited because of the low and very low available water capacity. Slope and rock fragments make renovation difficult. Fertilization and rotation grazing help keep the pasture plants and the soil in good condition.

The soils in this complex are suited to trees. The soil-related problems in forest management are associated with steepness of slope or with plant competition. Planting trees on the contour minimizes erosion, and skid roads should be located where they do not contribute to erosion. Seedling survival on the steeper slopes that face south or west is increased by careful planting of vigorous stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal. Skidding exposes sufficient mineral soil to allow adequate natural regeneration. Cobbles and stones on the surface, which are common on the Elderon soil, hinder the use of machinery for planting and harvest.

These soils generally are not suited to use as septic tank absorption fields because of the poor filtering capacity and slope. The soils are poorly suited to use as sites for dwellings with or without basements because of

the slope. Where the slope is less than about 20 percent, this limitation can be overcome by cutting and filling to modify the slope. Constructing dwellings to conform to the existing slope by use of retaining walls or columns also can overcome the limitation of slope.

These soils are poorly suited to local roads and streets because of slope. This limitation can be overcome, especially in the less sloping areas, by cutting and filling to shape the roadway or by building roads where the slope is less severe.

This complex is in capability subclass VII<sub>s</sub>; the Elderon soil is in woodland suitability subclass 3<sub>r</sub> and the Rosholt soil is in 2<sub>r</sub>.

**Fa—Fordum loam.** This is a nearly level, poorly drained and very poorly drained soil on flood plains. It is subject to frequent, long periods of flooding and ponding (fig. 4). Most areas are elongated and range from 5 to 400 acres in size.

Typically, the surface layer is very dark gray loam about 9 inches thick. The substratum in the upper 29 inches is dark gray, mottled, very friable loam that has many fine strata of gray sandy loam and very dark gray fine sandy loam. The lower part of the substratum to a depth of about 60 inches is gray, loose sand. In some places, the surface layer is sandy loam. In some small areas, the upper part of the substratum is loamy sand.

Included in mapping are small areas of Cathro, Markey, Roscommon, and Waupaca soils. Cathro and Markey soils are in slightly lower positions on the landscape than the Fordum soil. They formed in 16 to 51 inches of muck. The Roscommon soils are in depressions and broad drainageways. They are sandy throughout. The Waupaca soils are in positions on the landscape similar to those of the Fordum soil. They are mainly silty throughout. In some small areas, the soils have a muck surface layer up to 12 inches thick. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the loamy part of the soil and is rapid in the underlying loose sand. The available water capacity is moderate. The organic matter content is high or very high. Natural fertility is high. The soil ranges from medium acid to neutral throughout. Root development of many plants is limited because of wetness. The response to additions of plant nutrients is limited because of flooding and ponding.

In most areas, this soil is used as woodland. In some areas, it is in permanent pasture. In some small areas, it is used for marsh hay.

This soil generally is not suited to use as cropland because of frequent flooding and ponding. Because there are no outlets, it is not feasible to drain this soil in most areas. It is also difficult to protect crops from flooding and ponding.

This soil is poorly suited to use as pasture. It is difficult to establish improved pasture because of flooding and ponding. The quality of the native vegetation for forage is



Figure 4.—An area of Fordum loam. This soil is subject to frequent flooding and ponding.

mostly poor. Grazing is limited to short periods when this soil is dry.

This soil is suited to trees. Soil wetness during the tree planting season limits reforestation to natural regeneration. In harvesting, heavy equipment can be used only when the soil is frozen. Harvesting can be done by clearcutting or by an area-selection method that helps reduce windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields and as sites for dwellings and for local roads and streets. The main limitations are flooding and ponding. Because these limitations are difficult to overcome, the selection of a more favorable site should be considered.

This soil is in capability subclass Vw and in woodland suitability subclass 3w.

**HnB—Hortonville fine sandy loam, 2 to 6 percent slopes.** This is a gently sloping, well drained soil on convex ridgetops and on the lower side slopes. Most areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 9 inches thick. The subsoil is about 19 inches thick. It is mostly brown, firm sandy clay loam in the upper part; reddish brown, firm clay loam in the middle part; and reddish brown, firm loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, calcareous fine sandy loam. In some places, the surface layer is loamy sand. In some small areas as much as 4 inches of the surface layer has eroded away.

Included in mapping are small areas of the Kennan, Plainfield, and Symco soils. The Kennan and Plainfield soils and the Hortonville soil are in similar positions on the landscape. The Kennan soils are bouldery and are

well drained. They have less clay in the subsoil than the Hortonville soil. The Plainfield soils are excessively drained and are sandy throughout. The Symco soils are somewhat poorly drained; they are in slight depressions and in drainageways. In some small areas, dolomite bedrock is at a depth of 40 to 60 inches. In some small areas, there are mottles in the lower part of the subsoil, and permeability is moderately slow. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Hortonville soil is moderate, and the available water capacity is high. The organic matter content in the surface layer is moderate. Natural fertility is medium. The surface layer and subsoil are mildly alkaline to medium acid. The substratum is mildly alkaline or moderately alkaline. There are free carbonates in the substratum. The surface layer is friable and is easily tilled within a wide range of moisture content. The shrink-swell potential of this soil is moderate. This soil responds well to additions of plant nutrients, which should be applied in amounts based on soil tests.

In most areas, this soil is used as cropland. In a few areas, it is used as woodland or pasture.

This soil is suited to corn and small grains and to grasses and legumes for hay. If this soil is cultivated, erosion is a slight or moderate hazard. Minimum tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In many areas, slopes are long and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material improves fertility and water infiltration.

The use of this soil as pasture is effective in controlling erosion. Overgrazing or grazing when the soil is wet increases surface compaction, which reduces infiltration and increases runoff. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. The only soil-related problem in forest management is competing vegetation, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal.

This soil is only moderately suited to use as septic tank absorption fields because of the moderate permeability. This limitation can be overcome by increasing the size of the absorption field or by constructing a filtering mound of suitable material.

This soil is only moderately suited to use as sites for dwellings, with or without basements because of the moderate shrink-swell potential. Damage to structures caused by shrinking and swelling can be prevented by using a coarse fill, such as sand or gravel, under the foundation and, for dwellings with basements, by backfilling around the foundation with a similar coarse material.

This soil is poorly suited to local roads and streets because of low strength. This limitation can be overcome

by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase material also helps offset the low strength of this soil.

This soil is in capability subclass IIe and in woodland suitability subclass 1o.

**HrC2—Hortonville loam, 6 to 12 percent slopes, eroded.** This is a sloping, well drained soil on convex side slopes of ridges and knolls. Most areas are irregular in shape and range from 5 to 200 acres in size.

In most cultivated areas, on the crest of ridges and knolls and on upper side slopes, the original surface layer has been lost through erosion. Typically, the surface layer in cultivated areas is brown loam about 6 inches thick. The subsoil is reddish brown and is about 21 inches thick. It is mostly firm clay loam in the upper part and firm loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, calcareous fine sandy loam. In some places, near the base of slopes and in swales, the surface layer is very dark grayish brown fine sandy loam that is 10 to 20 inches thick. In some places, the surface layer is fine sandy loam or silt loam, and it is not eroded.

Included in mapping are small areas of the Kennan and Rosholt soils. These soils are well drained, and they and the Hortonville soil are in similar positions on the landscape. The Kennan soils are bouldery and have less clay in the subsoil than the Hortonville soil. The Rosholt soils have stratified sand and gravel in the substratum. Also included are small areas where the plow layer is part of the clay loam subsoil. In some small areas, dolomite bedrock is at a depth of 40 to 60 inches. In some small areas, the slope is more than 12 percent. In some small areas, the soils have moderately slow permeability. In some small areas, the soils are similar to the Hortonville soil, except that the surface layer and the upper part of the subsoil are loamy sand. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Hortonville soil is moderate, and the available water capacity is high. The organic matter content of the surface layer is moderately low. Natural fertility is medium. Reaction in the surface layer and subsoil is mildly alkaline to medium acid. It is mildly alkaline or moderately alkaline in the substratum. There are free carbonates in the substratum. The surface layer is friable. It can be tilled only within a narrow range of moisture content. Clods form if the soil is tilled when wet because some subsoil material has been mixed into the plow layer. This soil responds well to additions of plant nutrients, which should be applied in amounts based on soil tests.

In most areas, this soil is used as cropland. In a few areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. If this soil is cultivated, erosion is a moderate hazard. This soil is difficult to till

because it is eroded and some of the subsoil is exposed. Following heavy rains, this soil is subject to crusting and puddling, which result in poor emergence of small seeded crops. Minimum tillage, winter cover crops, and grassed waterways help to prevent excessive soil loss. In many areas, slopes are long and uniform enough for contour cropping. Diversions can be used to reduce slope length. Returning crop residue to the soil or regularly adding other organic material improves fertility and water infiltration and reduces crusting and puddling.

The use of this soil as pasture is effective in controlling erosion. Overgrazing or grazing when the soil is wet increases soil compaction, which reduces infiltration and increases runoff. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This Hortonville soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is moderately suited to use as septic tank absorption fields. The moderate permeability and slope are limitations. The problem of moderate permeability can be overcome by increasing the size of the absorption field or by constructing a filtering mound of suitable material. The slope can be modified by cutting and filling, or a trench absorption system can be installed on the contour.

This soil is moderately suited to use as sites for dwellings with or without basements because of the moderate shrink-swell potential and slope. The shrinking and swelling can be prevented by using coarse fill, such as sand or gravel, under the foundation and by backfilling around the foundation with similar coarse material. The slope can be modified by cutting and filling. Designing dwellings to conform to the existing slope by use of retaining walls or columns also overcomes the slope limitation.

This soil is poorly suited to local roads and streets because of low soil strength. This limitation can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase material also helps offset the low strength.

This soil is in capability subclass IIIe and in woodland suitability subclass 1c.

**HrD2—Hortonville loam, 12 to 20 percent slopes, eroded.** This is a moderately steep, well drained soil on convex side slopes of ridges and hills. Most areas are elongated or irregular in shape and range from 5 to 40 acres in size.

In most cultivated areas, on the crest of hills and on upper side slopes, the original surface layer has been lost through erosion. Typically, in cultivated areas the

surface layer is brown loam about 6 inches thick. The subsoil is reddish brown and is about 19 inches thick. It is mostly firm clay loam in the upper part and firm loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, calcareous fine sandy loam. In some places, near the base of slopes and in swales, the surface layer is very dark grayish brown fine sandy loam that is 10 to 20 inches thick. In some small areas, the surface layer is fine sandy loam or silt loam, or it is not eroded.

Included in mapping are small areas of the Kennan and Rosholt soils. These soils are well drained, and they and the Hortonville soil are in similar positions on the landscape. The Kennan soils are bouldery and have less clay in the subsoil than the Hortonville soil. The Rosholt soils have a stratified sand and gravel substratum. In some small areas, the slope is more than 20 percent; and in some small areas, there are many stones on the surface. In some small areas, the plow layer is clay loam. In some small areas, the soils are similar to the Hortonville soil, except that the surface layer is loamy sand. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Hortonville soils is moderate, and the available water capacity is high. The organic matter content in the surface layer is moderately low. Natural fertility is medium. Reaction is mildly alkaline to medium acid in the surface layer and subsoil. It is mildly alkaline or moderately alkaline in the substratum. There are free carbonates in the substratum. The surface layer is friable. Clods form if the soil is tilled when wet because some subsoil material has been mixed into the plow layer. This soil responds well to additions of plant nutrients, which should be applied in amounts based on soil tests.

In most areas, this soil is used as cropland. In a few areas, it is used as pasture or woodland.

This soil is poorly suited to row crops. It is suited to small grains and to grasses and legumes for hay. If this soil is cultivated, erosion is a severe hazard. This soil is difficult to till because it is eroded and some of the subsoil is exposed. Following heavy rains, the soil is subject to crusting and puddling, which result in poor emergence of small seeded crops. Minimum tillage, winter cover crops, and grassed waterways reduce soil loss. In many areas, slopes are long and uniform enough for contour cropping. Diversions can be used to reduce the length of the slope. A long rotation that includes only 1 year of row crops helps to control erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility and water infiltration and reduces crusting and puddling.

The use of this soil as pasture is effective in controlling erosion. Overgrazing or grazing when the soil is wet increases soil compaction, which reduces infiltration and increases runoff. Fertilization, renovation, rotation grazing, and restricted use during wet periods

help keep the pasture plants and the soil in good condition.

This soil is suited to trees. The soil-related problems in forest management are associated with steepness of slope or with plant competition following harvest. Planting trees on the contour minimizes erosion, and skid roads should be located where they do not contribute to erosion. Seedling survival on the steeper slopes that face south or west is increased by the careful planting of vigorous stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal. Skidding exposes sufficient mineral soil to allow adequate natural regeneration.

This soil is poorly suited to use as septic tank absorption fields because of slope. This limitation can be overcome by reducing the slope by cutting and filling.

This soil is poorly suited to use as sites for dwellings with or without basements because of slope. This limitation can be overcome by reducing the slope by cutting and filling. Using retaining walls or columns so that dwellings conform to the existing slope also helps overcome the slope limitation.

This soil is poorly suited to local roads and streets because of low soil strength and slope. Low strength can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase also helps offset the low strength. The slope can be modified by cutting and filling to shape the roadway.

This soil is in capability subclass IVE; and in woodland suitability subclass 1r.

**KbB—Kennan bouldery sandy loam, 2 to 6 percent slopes.** This is a gently sloping, well drained soil on convex ridgetops and lower side slopes. Most areas are irregular in shape and range from 10 to 40 acres in size. Boulders and stones ranging from 10 to more than 100 inches in diameter cover 4 to 25 percent of the surface (fig. 5).

Typically, the surface layer is very dark gray, bouldery sandy loam about 2 inches thick. The subsurface layer is mostly brown sandy loam and is about 19 inches thick. The subsoil to a depth of about 60 inches is mostly brown, friable sandy loam. In some places, the surface layer is bouldery loamy sand.

Included in mapping are small areas of the Hortonville, Kranski, and Rosholt soils. These soils and the Kennan soil are in similar positions on the landscape. The Hortonville soils are well drained. They have more clay in the subsoil than the Kennan soil. The Kranski soils are somewhat excessively drained. They are sandy throughout. The Rosholt soils are well drained. They have a stratified sand and gravel substratum. Also included are areas of Kennan soil that have been

cleared of stones and boulders or that naturally have few stones and boulders. In some small areas, the Kennan soil has thin bands of silt and fine sand in the substratum. The included soils make up 5 to 15 percent of the map unit.

Permeability and the available water capacity of the Kennan soil are moderate. The organic matter content in the surface layer is moderate. Natural fertility is medium. The subsoil is strongly acid to neutral. The surface layer is friable, but in most areas this soil cannot be tilled unless the boulders and stones are removed. The response to additions of plant nutrients is limited because of the moderate available water capacity.

In most areas, this soil is used as cropland, pasture, or woodland. In some areas, the soil is used for recreational development or as habitat for wildlife.

This Kennan soil is suited to corn and small grains and to grasses and legumes for hay if the boulders and stones are removed. If this soil is cultivated, erosion is a slight or moderate hazard. Minimum tillage, winter cover crops, and grassed waterways help to prevent excessive soil losses. In many areas, slopes are long and uniform enough for contour cropping. Crop yields in most seasons are limited because of the moderate available water capacity. Sprinkler irrigation can be used in the larger less sloping areas. If the soil is irrigated, the rate of water application must be controlled to prevent runoff and erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility and water infiltration.

This soil is poorly suited to use as pasture in areas where boulders and stones have not been removed. The rock fragments greatly reduce the amount of surface available for vegetative growth, and they hinder or prevent pasture renovation by conventional methods. Where the rock fragments have been removed, this soil is suited to use as pasture. This use is effective in controlling erosion.

This soil is suited to trees. The soil-related problems in forest management are associated with boulders and stones on the surface and competing vegetation. Boulders hinder the use of machinery in planting and harvesting. Logs are damaged if they fall on the boulders during harvest. Large tractors are needed to move boulders out of skid roads. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides.

This soil is only moderately suited to use as septic tank absorption fields and as sites for dwellings with or without basements because of the large stones. The stones can be removed by mechanical means.

This soil is moderately suited to local roads and streets because of the hazard of frost damage and large stones. Frost damage can be prevented by covering or replacing the upper part of the soil with a coarse base

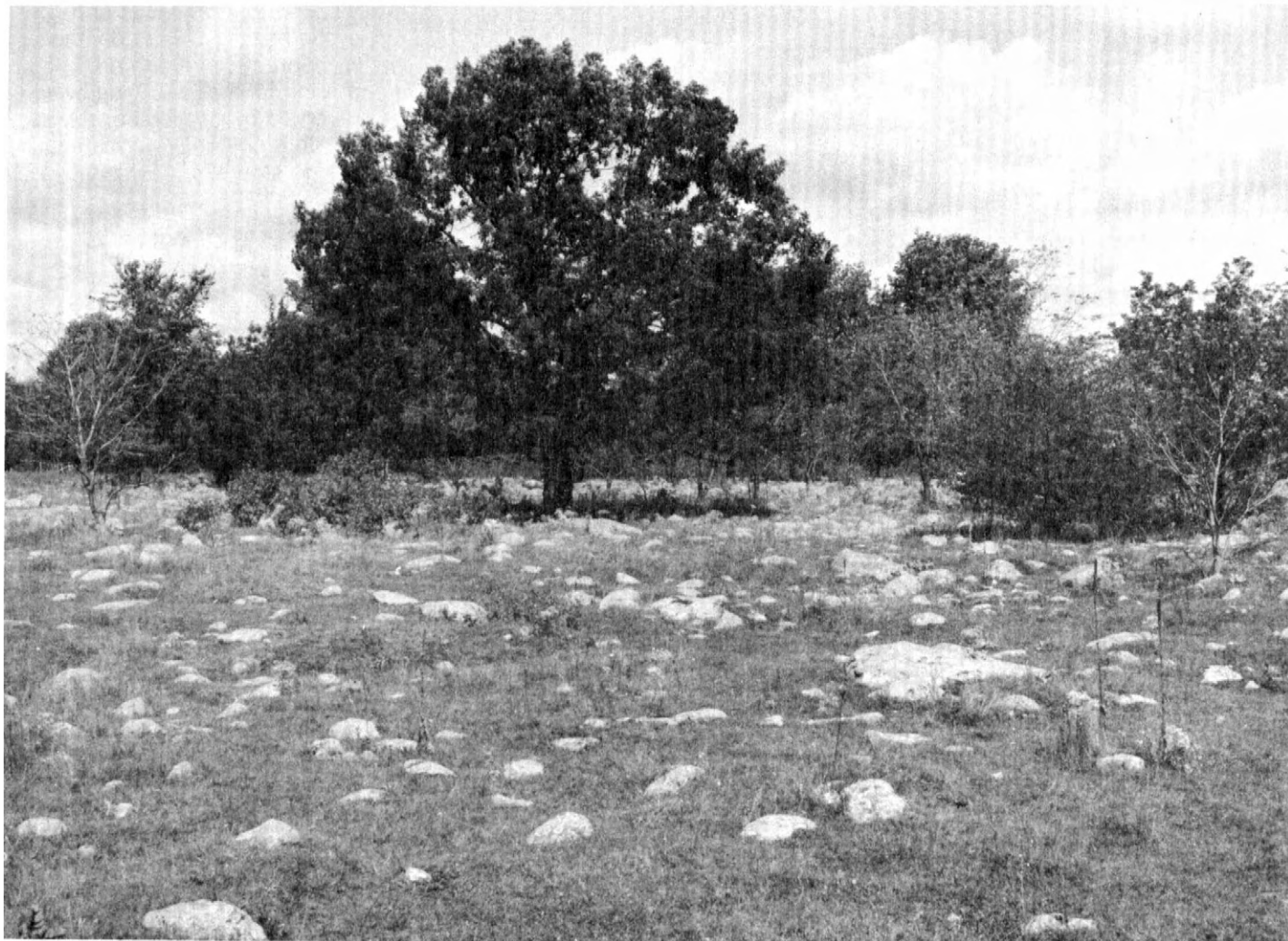


Figure 5.—An area of Kennan bouldery sandy loam, 2 to 6 percent slopes. Stones and boulders cover 4 to 25 percent of the surface.

material, such as sand or gravel. Large stones can be removed by mechanical means.

This soil is in capability subclass IIe, if the boulders are removed, and in woodland suitability subclass 1x.

**KbC—Kennan bouldery sandy loam, 6 to 12 percent slopes.** This is a sloping, well drained soil on convex ridgetops and lower side slopes. Most areas are irregular in shape and range from 10 to 80 acres in size. Boulders and stones ranging from 10 inches to more than 100 inches in diameter cover 4 to 25 percent of the surface.

Typically, the surface layer is very dark gray, bouldery sandy loam about 2 inches thick. The subsurface layer is mostly brown sandy loam and is about 19 inches thick. The subsoil to a depth of about 60 inches is mostly brown, friable sandy loam.

Included in mapping are small areas of Elderon, Hortonville, Kranski, and Rosholt soils. Elderon soils are stony and are somewhat excessively drained. Rosholt soils are well drained. The Elderon and Rosholt soils are on short, choppy side slopes of ridges and knolls. Unlike the Kennan soil, they have a sand and gravel substratum at a depth of 20 to 50 inches. The Hortonville and Kranski soils and the Kennan soil are in similar positions on the landscape. The Hortonville soils are well drained; they have more clay in the subsoil than the Kennan soil. The Kranski soils are somewhat excessively drained and are sandy throughout. Also included are areas of the Kennan soil that have been cleared of rock fragments or that naturally have fewer such fragments. In some areas, the Kennan soil has lost most of the original surface layer through erosion. In those areas, the plow layer is

brown sandy loam. The included soils make up 5 to 15 percent of the map unit.

Permeability and the available water capacity of this Kennan soil are moderate. The content of organic matter in the surface layer is moderate. Natural fertility is medium. The subsoil is strongly acid to neutral. The surface layer is friable, but in most areas the boulders and stones hinder tillage. The response to additions of plant nutrients is limited because of the moderate available water capacity.

In most areas, this soil is used as woodland. In cleared areas, it is used as cropland. In some areas, the soil is used as pasture or for recreational development or as habitat for wildlife.

This soil is suited to corn and small grains and to grasses and legumes for hay if the boulders and stones are removed. If this soil is cultivated, erosion is a moderate hazard. Minimum tillage, winter cover crops, and grassed waterways help to prevent excessive soil losses. In many areas, slopes are long and uniform enough for contour cropping. Diversions can be used to reduce the length of the slope. Crop yields in most seasons are limited because of the moderate available water capacity. This soil is poorly suited to irrigation because of slope and the danger of runoff and erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility and water infiltration.

This soil is poorly suited to use as pasture in areas where boulders and stones have not been removed. The rock fragments greatly reduce the amount of surface available for vegetative growth, and they hinder or prevent pasture renovation by conventional methods. Where the rock fragments have been removed, this soil is suited to use as pasture. This use is effective in controlling erosion.

This soil is suited to trees. The soil-related problems in forest management are associated with boulders and stones on the surface and with competing vegetation. Boulders hinder the use of machinery in planting and harvesting. Logs are damaged if they fall on the boulders during harvest. Large tractors are needed to move the boulders out of skid roads. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides.

This soil is only moderately suited to use as septic tank absorption fields because of the large stones and the slope. Large stones can be removed by mechanical means. Slopes can be modified by cutting and filling or by installing a trench absorption system on the contour.

This soil is only moderately suited to use as sites for dwellings with or without basements because of slope and the large stones. Cutting and filling can be used to modify the slope. Designing dwellings to conform to the existing slope also overcomes the slope limitation. Large stones can be removed by mechanical means.

This soil is moderately suited to local roads and streets because of slope, the hazard of frost damage, and large stones. The limitation of slope can be overcome by cutting and filling to shape the roadway. Frost damage can be prevented by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Large stones can be removed by mechanical means.

This soil is in capability subclass IIIe, if the boulders are removed, and woodland suitability subclass 1x.

**KbD—Kennan bouldery sandy loam, 12 to 30 percent slopes.** This is a moderately steep and steep, well drained soil on convex side slopes of ridges and hills. Most areas are elongated or irregular in shape and range from 10 to 100 acres in size. Boulders and stones ranging from 10 to more than 100 inches in diameter cover 4 to 25 percent of the surface.

Typically, the surface layer is very dark grayish brown bouldery sandy loam about 4 inches thick. The subsurface layer is mostly yellowish brown sandy loam and is about 18 inches thick. The subsoil to a depth of about 60 inches is reddish brown, friable sandy loam. In some places, the surface layer is bouldery loamy sand.

Included in mapping are small areas of the Elderon, Kranski, and Rosholt soils. These soils and the Kennan soil are in similar positions on the landscape. The Elderon soils are stony and are somewhat excessively drained. They have a sand and gravel substratum at a depth of 20 to 50 inches. The Kranski soils are somewhat excessively drained and are sandy throughout. The Rosholt soils are well drained, and they have a sand and gravel substratum at a depth of 20 to 50 inches. In some areas, the Kennan soil has been cleared of rock fragments, or it naturally has few such fragments. In some small areas, slope is more than 30 percent. The included soils make up 5 to 15 percent of the map unit.

Permeability and the available water capacity of this Kennan soil are moderate. The organic matter content in the surface layer is moderate. Natural fertility is medium. The subsoil is strongly acid to neutral. The surface layer is friable, but in most areas the soil cannot be tilled unless the boulders and stones are removed. The response to additions of plant nutrients is limited because of the moderate available water capacity.

In most areas, this soil is used as woodland. In most cleared areas this soil is used as pasture. In some areas, it is used for recreational development or as habitat for wildlife.

This soil generally is not suited to use as cropland unless the boulders and stones are removed from the surface. Erosion is a severe hazard in areas where the soil has been cleared of boulders and is used for cultivated crops.

This soil is poorly suited to use as pasture in areas where boulders and stones have not been removed. The

rock fragments greatly reduce the soil surface available for vegetative growth, and they hinder or prevent pasture renovation by conventional methods. Where the rock fragments have been removed, this soil is suited to use as pasture. This use is effective in controlling erosion.

This soil is suited to trees. Soil-related problems in forest management are associated with steepness of slope, boulders on the surface, and competing vegetation. Planting trees on the contour minimizes erosion, and skid roads should be located where they do not contribute to erosion. Boulders on the surface hinder the use of machinery in planting and harvesting. Logs are damaged if they fall on the boulders during harvest. Large tractors are needed to move the boulders out of the skid roads. Seedling survival on the steeper slopes that face south and west can be increased by the careful planting of vigorous stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal. Skidding exposes sufficient mineral soil to allow adequate natural regeneration.

This soil is poorly suited to use as septic tank absorption fields because of the slope. Because this limitation is difficult to overcome, the selection of a more favorable site should be considered. Where the slope is less than about 20 percent, cutting or cutting and filling overcomes the limitation. This soil is poorly suited to use as sites for dwellings with or without basements because of slope. Where the slope is less than about 20 percent, it can be modified by cutting and filling. In these areas, designing dwellings to conform to the existing slope also overcomes the slope limitation.

This soil is poorly suited to local roads and streets because of slope. This limitation can be overcome, especially in the less sloping areas, by cutting and filling to shape the roadway or by building the road where slope is not a severe limitation.

This soil is in capability subclass VIIIs and in woodland suitability subclass 1r.

#### **KrB—Kranski loamy sand, 2 to 6 percent slopes.**

This is a gently sloping, somewhat excessively drained soil on convex ridgetops and the lower side slopes. Most areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is dark brown loamy sand about 6 inches thick. The subsoil is very friable loamy sand about 25 inches thick. It is yellowish brown in the upper part and dark brown in the lower part. The substratum to a depth of about 60 inches is dark brown, very friable gravelly loamy sand. In some places, soil blowing has removed up to 4 inches of the surface layer.

Included in mapping are small areas of Kennan, Plainfield, and Richford soils. They and the Kranski soil are all in similar positions on the landscape. The Kennan soils are bouldery and are well drained. They are sandy loam throughout. The Plainfield soils are excessively

drained. They have less clay in the subsoil than the Kranski soil. The Richford soils are somewhat excessively drained. They have a sandy loam layer in the subsoil. In some small areas, there are many stones on the surface and in the subsoil and substratum. In other areas, there are soils that are similar to the Kranski soil, except that they have sand or sand and gravel below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Kranski soil is moderately rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. Reaction is slightly acid to strongly acid in the surface layer and subsoil and medium acid to mildly alkaline in the substratum. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In many areas, this soil is used as cropland. In some areas, it is used as pasture or woodland or for recreational development or as habitat for wildlife.

This soil is moderately suited to corn and small grains and to grasses and legumes for hay. Crop yields are limited because of the low available water capacity. If this soil is used for cultivated crops, soil blowing is a hazard. Minimum tillage, windbreaks, and winter cover crops reduce losses from soil blowing. Sprinkler irrigation can be used in the larger, less sloping areas. In some areas, stones on the surface hinder cultivation and require removal. Returning crop residue to the soil or regularly adding other organic material improves fertility and the water infiltration rate, helps retain soil moisture, and reduces soil blowing.

The use of this soil as pasture is effective in controlling soil blowing. Pasture yields are limited because of the low available water capacity. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by the careful planting of vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it can not adequately filter it. The poor filtering capacity can result in pollution of ground water. The soil is suited to use as dwelling sites with or without basements and to local roads and streets.

This soil is in capability subclass IIIs and in woodland suitability subclass 3s.

#### **KrC—Kranski loamy sand, 6 to 12 percent slopes.**

This is a sloping, somewhat excessively drained soil on convex side slopes of ridges and knolls. Most areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsoil is very friable loamy sand about 26 inches thick. It is dark brown in the upper part and reddish brown in the lower part. The substratum to a depth of about 60 inches is dark brown, very friable loamy sand. In some places, soil blowing or erosion has removed as much as 4 inches of the surface layer.

Included in mapping are small areas of the Kennan and Plainfield soils. These soils and the Kranski soil are in similar positions on the landscape. The Kennan soils are bouldery and are well drained. They are sandy loam throughout. The Plainfield soils are excessively drained. They have less clay in the subsoil than the Kranski soil. In some small areas, the soil has many stones on the surface and in the subsoil and substratum. In some small areas, there are soils similar to the Kranski soil, except that they have sand or sand and gravel below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Kranski soil is moderately rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. Reaction is slightly acid to strongly acid in the surface layer and subsoil and medium acid to mildly alkaline in the substratum. The surface layer is friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In many areas, this soil is used as cropland. In some areas, it is used as woodland or pasture or for recreational development or as habitat for wildlife.

This soil is moderately suited to corn and small grains and to grasses and legumes for hay. Crop yields are limited in most seasons because of the low available water capacity. If the soil is cultivated, soil blowing is a hazard, and erosion is a moderate hazard. Minimum tillage, winter cover crops, grassed waterways, and windbreaks reduce soil losses from blowing and erosion. This soil is poorly suited to irrigation because runoff and erosion increase if water is applied too rapidly. In some areas, stones on the surface hinder cultivation. Returning crop residue to the soil or regularly adding other organic material improves fertility and the water infiltration rate, helps retain soil moisture, and reduces soil blowing and erosion.

The use of this soil as pasture is effective in controlling soil blowing and erosion. Pasture yields are limited because of the low available water capacity. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This Kranski soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it can not adequately filter it.

The poor filtering capacity can result in the pollution of ground water. This soil is only moderately suited to use as sites for dwellings with or without basements because of the slope. This limitation can be overcome by cutting and filling to modify the slope. Designing dwellings to conform to the existing slope also overcomes the slope limitation.

This soil is moderately suited to local roads and streets because of the slope. This limitation can be overcome by cutting and filling to shape the roadway.

This soil is in capability subclass IIIe and in woodland suitability subclass 3s.

#### **KrD—Kranski loamy sand, 12 to 20 percent slopes.**

This is a moderately steep, somewhat excessively drained soil on convex side slopes of ridges and hills. Most areas are elongated or irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 4 inches thick. The subsurface layer is yellowish brown loamy sand about 3 inches thick. The subsoil is dark brown, very friable loamy sand about 22 inches thick. The substratum to a depth of about 60 inches is dark brown, very friable gravelly loamy sand.

Included in mapping are small areas of the Kennan and Plainfield soils. These soils and the Kranski soil are in similar positions on the landscape. The Kennan soils are bouldery and are well drained. They are sandy loam throughout. The Plainfield soils are excessively drained. They have less clay in the subsoil than the Kranski soil. In some small areas of the Kranski soil, the slope is more than 20 percent, and in other areas on ridgetops, the slope is less than 12 percent. In some small areas, the soils are similar to the Kranski soil, but they have sand or sand and gravel below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Kranski soil is moderately rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. The reaction is slightly acid to strongly acid in the surface layer and subsoil and medium acid to mildly alkaline in the substratum. The surface layer is friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as pasture or woodland. In some areas, it is used for recreational development or as habitat for wildlife.

This Kranski soil is poorly suited to corn and small grains and is moderately suited to grasses and legumes for hay. If this soil is cultivated, soil blowing is a hazard, and erosion is a severe hazard. It is difficult to operate farm equipment in the more sloping areas of this soil. Crop yields in most seasons are limited because of the low available water capacity.

The use of this soil as pasture is effective in controlling erosion. Pasture yields are limited because of the low available water capacity. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This Kranski soil is suited to trees. Planting trees on the contour controls erosion, and skid roads should be located where they will not contribute to erosion. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields because of slope and poor filtering capacity. This soil is poorly suited to use as sites for dwellings with or without basements because of slope. This limitation can be overcome by cutting and filling to modify the slope. Designing dwellings to conform to the existing slope also overcomes the slope limitation.

This soil is poorly suited to local roads and streets because of slope. This limitation can be overcome by cutting and filling to shape the roadway.

This Kranski soil is in capability subclass IVe and in woodland suitability subclass 3s.

**Lx—Loxley mucky peat.** This is a nearly level, very poorly drained soil in depressions. It is subject to long periods of ponding. Most areas are irregular or circular in shape and range from 5 to 300 acres in size.

Typically, this soil is dark brown, black, or very dark brown muck to a depth of at least 60 inches. In most areas, a thin carpet of live sphagnum moss is on the surface. In some places, woody fragments or thin layers of peat are below the surface.

Included in mapping are small areas of the Cathro, Markey, and Seelyville soils, all of which are very poorly drained. Their positions on the landscape are similar to those of the Loxley soil, but they are less acid than the Loxley soil. The Cathro and Markey soils are underlain by mineral soil at a depth between 16 and 51 inches. In some small areas, the soils are covered with water during most of the year. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Loxley soil is moderately rapid, and the available water capacity is very high. The organic matter content of the organic layers is very high. Natural fertility is low. This soil is extremely acid throughout. Wetness and extreme acidity restrict the root development of most plants.

In most areas, this soil is in natural vegetation, which is primarily sphagnum moss and leatherleaf.

This Loxley soil generally is not suited to use as cropland. The major problems are wetness, extreme acidity, and the danger of frost damage to the crops.

This soil generally is not suited to use as pasture. The combination of wetness and extreme acidity limits the growth of pasture plants.

This soil is not suited to trees. It does not support the growth of trees of merchantable size and quality. Good land use can include management of woody cover as habitat for wildlife.

This soil generally is not suited to use as septic tank absorption fields or as sites for dwellings or for local roads and streets, mainly because of ponding, low stability, and the hazard of frost damage. These limitations are difficult to overcome, and the selection of a more favorable site should be considered.

This soil is in capability subclass VIIw, undrained. It was not assigned to a woodland capability subclass.

**Mh—Meehan loamy sand.** This is a nearly level, somewhat poorly drained soil in drainageways and shallow swales. Most areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is about 17 inches thick. It is brown, mottled, very friable loamy sand in the upper part and brown and yellowish brown, mottled, very friable sand in the lower part. The substratum to a depth of about 60 inches is light brown, mottled, loose sand. In some places, the subsoil is as much as 20 percent gravel. In some small areas, the surface layer is sandy loam.

Included in mapping are small areas of Oesterle and Roscommon soils and of the wet substratum phase of Plainfield soils. The Meehan soil and the Roscommon and Plainfield soils formed in similar deposits. The Roscommon soils are poorly drained. They are in depressions and broad drainageways. The Plainfield, wet substratum, soil is moderately well drained. It is slightly higher on the landscape than the Meehan soil. The Oesterle soils are somewhat poorly drained. They are in positions on the landscape similar to those of the Meehan soil, but they have more clay in the surface layer and the upper part of the subsoil than the Meehan soil. In some small areas, the Meehan soil has thin bands of silt and fine sand below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Meehan soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is moderately low. Natural fertility is low. Reaction is neutral to strongly acid in the surface layer and subsoil and medium acid to neutral in the substratum. The surface layer is very friable and is easily tilled within a wide range of moisture content. Unless this soil is drained, the seasonal high water table restricts root development of most plants. The response to additions of plant nutrients is limited by wetness and the low available water capacity.

In many areas, this soil is used as cropland. In some areas, it is used as pasture, woodland, or habitat for wildlife.

If drained, this Meehan soil is suited to corn and small grains and to grasses and legumes for hay. Soil blowing is a hazard in cultivated areas in dry periods. The low available water capacity limits crop yields in most seasons. Alfalfa is subject to winterkill from frost heave in the undrained areas. The suitability for crops can be improved if the soil is drained by open ditches and if it is irrigated by a sprinkler system. If sand enters the tile lines, the tile drains can become clogged.

This soil is moderately suited to use as pasture. The kinds of forage plants that will grow on this soil are limited because of the seasonal high water table. Yields in most seasons are limited because of the low available water capacity. Overgrazing or grazing when the soil is wet damages the vegetative cover. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Planting the seedlings on prepared ridges reduces the effect of wetness. Seedling survival can be increased by planting vigorous nursery stock. Trees generally are harvested only when the soil is frozen. Clearcutting or harvesting according to a group-selection method reduces windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the poor filtering capacity of the soil. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings with or without basements because of wetness. This limitation can be overcome by installing tile drains around the foundation. A gravity outlet or other dependable outlet is needed. Raising the site elevation above the level of wetness with fill material also overcomes the wetness problem.

This soil is moderately suited to local roads and streets because of wetness and the hazard of frost damage. These problems can be corrected by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel, to raise the roadbed above the level of wetness and using open ditches or a subsurface drainage system to lower the seasonal water table.

This Meehan soil is in capability subclass IVw and in woodland suitability subclass 3w.

**MIA—Meehan loamy sand, loamy substratum, 0 to 3 percent slopes.** This is a nearly level and gently sloping, somewhat poorly drained soil in drainageways and shallow swales. Most areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is black loamy sand about 9 inches thick. The subsoil is yellowish brown, mottled,

very friable, loose sand about 22 inches thick. The substratum is light brownish gray, mottled, loose sand in the upper 12 inches, and it is reddish brown, friable loam in the lower part, to a depth of about 60 inches. In some places, there are bands of silt and fine sand in the lower part of the substratum.

Included in mapping are small areas of Meehan soils that do not have a loamy layer in the substratum. Also included are small areas of the loamy substratum phase of Plainfield soils and small areas of Roscommon and Symco soils. The Plainfield, loamy substratum, soil and the Meehan soil formed in similar deposits, but the Plainfield soil is excessively drained. It is on convex ridgetops, in positions on the landscape slightly higher than those of the Meehan soil. The Roscommon soils are poorly drained and are sandy throughout. They are in depressions and broad drainageways, in slightly lower positions than those of the Meehan soil. The Symco soils are in positions on the landscape similar to those of the Meehan soil, but they have more clay in the solum and the upper part of the substratum. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the subsoil and upper part of the substratum of this Meehan soil and moderate in the lower part of the substratum. The available water capacity is low. The organic matter content in the surface layer is moderately low. Natural fertility is low. Reaction is neutral in the surface layer and subsoil and in the upper part of the substratum, and it is mildly alkaline in the lower part of the substratum. There are free carbonates in the lower part of the substratum. The surface layer is very friable and is easily tilled within a wide range in moisture content. Unless the soil is drained, the seasonal high water table restricts root development of most plants. The response to additions of plant nutrients is limited because of wetness and the low available water capacity.

In many areas, this soil is used as cropland. In some areas, it is used as pasture, woodland, or habitat for wildlife.

If drained, this soil is moderately suited to corn and small grains and to grasses and legumes for hay. This soil has a seasonal high water table that is easily lowered by a tile drainage system. Because it slows water movement in dry periods, the loamy substratum is not a limiting factor. Soil blowing is a hazard in cultivated areas in dry periods. Alfalfa is subject to winterkill by frost heave in undrained areas. The suitability for crops can be improved if the soil is drained by tile drains or open ditches and, to counter the low available water capacity, if the soil is irrigated by a sprinkler system. This soil is suited to vegetable crops if it is drained and irrigated.

This soil is moderately suited to use as pasture. The kinds of forage plants that will grow on this soil are limited because of the seasonal high water table. Yields in most seasons are limited because of the low available

water capacity. Overgrazing or grazing when the soil is wet damages the vegetative cover. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This Meehan soil is suited to trees. Planting the seedlings on prepared ridges reduces the effect of wetness. Seedling survival can be increased by planting vigorous nursery stock. Trees are generally harvested only when the soil is frozen. Clearcutting or harvesting according to a group-selection method reduces windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the poor filtering capacity of the soil. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings with or without basements because of wetness. This limitation can be overcome by installing tile drains around the foundation. A gravity outlet or other dependable outlet is needed. Raising the site elevation above the level of wetness with fill material also overcomes the wetness problem.

This soil is moderately suited to local roads and streets because of wetness and frost damage. These problems can be corrected by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel, to raise the roadbed above the level of wetness and by using open ditches or a subsurface drainage system to lower the seasonal water table.

This Meehan soil is in capability subclass IVw and in woodland suitability subclass 3w.

**Mp—Menasha silty clay.** This is a nearly level, poorly drained soil in depressions and broad drainageways. It is subject to long periods of ponding. Most areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is black silty clay about 12 inches thick. The subsoil is about 17 inches thick. It is gray, mottled, firm clay in the upper part and gray and reddish brown, firm clay in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, firm, calcareous clay. In some places, the surface layer is silty clay loam, and in other places there are thin strata of silt in the substratum below a depth of 40 inches. In some small areas, the soil has less clay throughout.

Included in mapping are small areas of the Cathro, Markey, and Neenah soils. The Cathro and Markey soils are very poorly drained. They are in lower positions on the landscape than the Menasha soil. They are in depressions and formed in 16 to 51 inches of muck. Neenah soils are somewhat poorly drained. They and the Menasha soil formed in similar deposits, but the

Neenah soils, which are in drainageways, are in slightly higher positions on the landscape. In some small areas, the Menasha soil has a muck surface layer as much as 12 inches thick. The included soils make up 5 to 10 percent of the map unit.

Permeability of the Menasha soil is slow or very slow, and the available water capacity is moderate. The organic matter content in the surface layer is high. Natural fertility is high. Reaction is neutral or mildly alkaline in the surface layer and subsoil and is mildly alkaline or moderately alkaline in the substratum. There are free carbonates in the substratum. Because the surface layer is firm and clayey, clods form if the soil is tilled when it is too moist. Root development of many plants is limited because of ponding, the seasonal high water table, and the density of the subsoil and substratum. The shrink-swell potential is high in the subsoil and substratum. The response to additions of plant nutrients is limited because of ponding, wetness, and poor tilth.

For most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

If drained and protected from ponding, this soil is suited to corn. Alfalfa is subject to winterkill from frost heave. If tile drainage is used where there are thin strata of silt in the substratum, loose silt can enter the tile lines and clog them unless a suitable filter is used to cover the tile. Returning crop residue to the soil or regularly adding other organic material improves fertility, water infiltration, and tilth.

This soil is poorly suited to use as pasture unless it is drained. Overgrazing or grazing when the soil is too moist increases soil compaction and reduces yields. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Because of wetness, seedlings generally should be planted on prepared ridges if natural regeneration is unreliable. Planting vigorous nursery stock is essential to reduce seedling mortality. Harvesting generally is done only when the soil is frozen. Harvesting by clearcutting or by a group-selection method reduces danger of windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields or as sites for dwellings because of ponding, the slow or very slow permeability of the soil, and the high shrink-swell potential. Because these limitations are difficult to overcome, the selection of a more favorable site should be considered.

This soil is poorly suited to local roads and streets because of low strength, ponding, and the hazard of frost damage. The limitations of low strength and frost damage can be overcome by using open ditches or subsurface drains along the roadbed and by covering or

replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, and subbase material also helps offset the low soil strength. Ponding can be prevented by using fill material to construct the road above the ponding level and installing equalizing culverts to prevent road damage. Surface water can be removed by side ditches and culverts.

This Menasha soil is in capability subclass 1lw, drained, and in woodland suitability subclass 2w.

**MrB—Military loamy sand, 3 to 8 percent slopes.**

This is a gently sloping and sloping, moderately deep, well drained soil on convex ridgetops and side slopes. Most areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 10 inches thick. The subsoil is about 17 inches thick. It is yellowish red, very friable sandy loam in the upper part; reddish brown, firm sandy clay loam in the middle part; and yellowish red firm loam in the lower part. The substratum at a depth of about 27 inches, is yellowish brown, weathered sandstone. Unweathered sandstone bedrock is at a depth of about 33 inches. In some places, the surface layer is sandy loam or loamy fine sand.

Included in mapping are small areas of the Hortonville, Shawano, Symco, and Whalan soils. The Hortonville, Shawano, and Whalan soils and the Military soil are in similar positions on the landscape. The Hortonville soils are well drained. They have a fine sandy loam substratum. The Shawano soils are excessively drained. They are sandy throughout. The Whalan soils are also well drained. They are underlain by dolomitic bedrock. The Symco soils, which are in drainageways, are in lower positions on the landscape than the Military soil. They are somewhat poorly drained, and they have a clay loam substratum. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Military soil is moderate, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is medium. This soil is neutral to strongly acid throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. Root development of deep-rooted plants, such as alfalfa, is restricted by the sandstone bedrock. The response to additions of plant nutrients is limited because of the low available water capacity and the moderate rooting depth.

In most areas, this soil is used as cropland. In some areas, it is used as pasture.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If the soil is cultivated, erosion is a slight or moderate hazard, and the soil is subject to soil blowing. Minimum tillage, winter cover crops, grassed waterways,

and windbreaks help reduce soil blowing and erosion. In many areas, slopes are long and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material improves fertility and reduces soil blowing.

The use of this soil as pasture is effective in controlling erosion and soil blowing. Pasture yields in most seasons are limited because of the low available water capacity. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of the moderate depth to bedrock. This limitation can be overcome by constructing a filtering mound of suitable material.

This soil is suited to use as sites for dwellings without basements. It is only moderately suited to use as sites for dwellings with basements. The bedrock is a limitation, but the sandstone is soft and can be excavated with power equipment.

This soil is moderately suited to local roads and streets because of the hazard of frost damage. This limitation can be overcome by covering or replacing the upper part of the soil with coarse base material, such as sand or gravel.

This Military soil is in capability subclass 1le and in woodland suitability subclass 2o.

**Ms—Minocqua mucky fine sandy loam.** This is a nearly level, poorly drained soil in drainageways and depressions. It is subject to occasional brief periods of flooding and ponding. Most areas are elongated or irregular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is black mucky fine sandy loam about 7 inches thick. The subsoil is grayish brown, mottled, very friable and friable sandy loam about 30 inches thick. The substratum to a depth of about 60 inches is brown, mottled, loose sand. In some places, the surface layer is mucky loam or mucky silt loam. In some small areas, the substratum is as much as 50 percent gravel.

Included in mapping are small areas of the Angelica, Oesterle, and Roscommon soils. The Angelica and Roscommon soils are poorly drained. They and the Minocqua soil are in similar positions on the landscape. The Angelica soils have a loam subsoil and substratum. The Roscommon soils are sandy throughout. The Oesterle soils are somewhat poorly drained. They are in drainageways and are higher on the landscape than the Minocqua soil. In some small areas, there are soils that are similar to the Minocqua soil, except that they have thin bands of silt loam, loam, or very fine sand in the

substratum below a depth of 40 inches. In some small areas, the surface layer is muck and is as much as 12 inches thick. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the subsoil of this Minocqua soil and rapid or very rapid in the substratum. The available water capacity is moderate. The organic matter content in the surface layer is high. Natural fertility is medium. Reaction is medium acid or strongly acid in the surface layer and subsoil and is medium acid to neutral in the substratum. The surface layer is friable. Tillage is restricted because of wetness. Root development of most plants is limited because of the seasonal high water table. The response to additions of plant nutrients is limited because of wetness.

In most areas, this soil is in native vegetation, which is primarily water-tolerant grasses, sedges, and alder. In some areas the soil is used for pasture or woodland.

This soil generally is not suited to corn and small grains and to grasses and legumes for hay because of wetness, ponding, and flooding.

This soil is poorly suited to use as pasture unless it is drained. It is difficult to establish improved pasture because of the saturated soil conditions, occasional flooding, and ponding. The quality of native vegetation for forage is mostly poor. Grazing is limited to short periods when the soil is dry.

This Minocqua soil is poorly suited to trees. Growth is so slow and form so poor that trees are barely merchantable at best. Because of wetness, seedlings generally should be planted either by hand or machine on prepared ridges. Planting vigorous nursery stock is essential to reduce seedling mortality. Harvesting can be done only when the soil is frozen. Harvesting by clearcutting or by an area-selection method reduces windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields or as sites for dwellings, mainly because of flooding, ponding, and poor filtering. Because these limitations are difficult to overcome, the selection of a more favorable site should be considered.

This soil is poorly suited to local roads and streets because of ponding, flooding, and frost damage. These limitations can be overcome by using coarse fill material, such as sand or gravel, to raise the road above the level of flooding or ponding and installing equalizing culverts to prevent road damage. Surface water can be removed by culverts and side ditches.

This Minocqua soil is in capability subclass Vlw, undrained, and in woodland suitability subclass 3w.

**Ne—Nebago loamy sand, sandy substratum.** This is a nearly level, somewhat poorly drained soil in

drainageways and shallow swales. Most areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray loamy sand about 9 inches thick. The subsurface layer is light brownish gray loamy sand about 4 inches thick. The subsoil is about 35 inches thick. It is dark brown, loose sand in the upper part; dark yellowish brown, mottled, loose sand in the middle part; and reddish brown, mottled, firm silty clay in the lower part. The substratum is reddish brown, mottled, firm silty clay in the upper 6 inches and pale brown, mottled, loose sand in the lower part, to a depth of about 60 inches. In some places, the surface layer is sandy loam. In some small areas, the upper and middle parts of the subsoil are loamy sand.

Included in mapping are small areas of Meehan, Neenah, and Tustin soils. Meehan and Neenah soils are somewhat poorly drained. They and the Nebago soil are in similar positions on the landscape. Meehan soils are mostly sandy throughout, and Neenah soils are clayey throughout. Tustin soils are well drained. They and the Nebago soil formed in similar deposits, but the Tustin soils, on low ridges and knolls, are in slightly higher positions on the landscape. Also included are small areas of soils that are similar to the Nebago soil, except that they are poorly drained. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the surface and subsurface layers, moderately slow or slow in the subsoil and upper part of the substratum, and rapid in the lower part of the substratum. The available water capacity is low. The organic matter content in the surface layer is moderately low. Natural fertility is low. The surface layer and subsoil are neutral to medium acid, and the substratum is neutral to moderately alkaline. There are free carbonates below a depth of about 40 inches. The surface layer is very friable and is easily tilled within a wide range of moisture content. Unless the soil is drained, root development of most plants is limited because of the seasonal high water table. The shrink-swell potential is high in the subsoil and upper part of the substratum. The response to additions of plant nutrients is limited because of wetness and the low available water capacity.

This soil is used mainly as cropland. In some areas, it is used as pasture, woodland, or habitat for wildlife.

If drained, this soil is suited to corn and small grains and to grasses and legumes for hay. Soil blowing is a hazard in dry periods. Crop yields in most seasons are limited because of the low available water capacity. Alfalfa is subject to winterkill by frost heave. The suitability for crops can be improved if the soil is drained by open ditches and irrigated by a sprinkler system.

This soil is suited to use as pasture. The kinds of forage plants that will grow on this soil are limited because of the seasonal water table. Yields in most seasons are limited because of the low available water capacity. Overgrazing or grazing when the soil is wet damages the vegetative cover. Fertilization, renovation,

rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This Nebago soil is suited to trees. The only soil-related forest problem in management is plant competition, which interferes with natural regeneration following harvest. This vegetation can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the moderately slow or slow permeability. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings without basements because of wetness and for dwellings with basements because of wetness and a high shrink-swell potential in the clayey layers. The wetness problem can be corrected by using fill material to raise the site above the level of wetness or, at a site for dwellings with basements, by installing tile drains around the foundation. A gravity outlet or other dependable outlet is needed. The shrinking and swelling of the soil can be prevented by using a coarse fill material, such as sand or gravel, under the foundation and by backfilling around the foundation with a similar coarse material.

This soil is moderately suited to local roads and streets. The limitations of wetness and frost damage can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel, to raise the roadbed above the level of wetness and by installing an open ditch or subsurface drainage system to lower the seasonal water table.

This soil is in capability subclass IIIw and in woodland suitability subclass 2s.

**NhA—Neenah silty clay, 0 to 3 percent slopes.** This is a nearly level to gently sloping, somewhat poorly drained soil in drainageways. Most areas of this soil are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is black silty clay about 8 inches thick. The subsoil is brown and reddish brown, mottled, firm clay about 8 inches thick. The substratum to a depth of about 60 inches is reddish brown, mottled, calcareous clay. In some places, the surface layer is silty clay loam.

Included in mapping are small areas of Menasha, Nebago, and Oshkosh soils. The Neenah soil and the Menasha and Oshkosh soils formed in similar deposits. Menasha soils, however, are poorly drained and are in lower positions on the landscape, in depressions and broad drainageways. Oshkosh soils are well drained and are in higher positions; they are on convex ridges. Nebago soils are somewhat poorly drained. They and the Neenah soil are in similar positions on the landscape, but, unlike the Neenah soil, they formed in 20 to 40 inches of sandy material underlain by clay. In some small areas, the Neenah soil has thin bands of silt in the

substratum below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Neenah soil is slow or very slow, and the available water capacity is moderate. The organic matter content in the surface layer is moderate. Natural fertility is high. The surface layer and the subsoil are neutral or mildly alkaline, and the substratum is mildly alkaline or moderately alkaline. There are free carbonates in the substratum. Because the surface layer is firm and clayey, clods form if the soil is tilled when it is too moist. Unless the soil is drained, root development of most plants is limited because of the seasonal high water table and the density of the subsoil and substratum. The shrink-swell potential is high in the subsoil and substratum. The response to additions of plant nutrients is limited because of wetness and poor tilth.

This soil is used mainly as cropland. In some areas, it is used as pasture or woodland.

If drained, this Neenah soil is suited to corn and small grains. Alfalfa is subject to winterkill from ice sheeting and from frost heave. If tile drainage is used where there are thin strata of silt in the substratum, loose silt can enter and block the tile lines unless a suitable filter is used to cover the tile. Returning crop residue to the soil or regularly adding other organic material improves fertility, water infiltration, and tilth.

This soil is suited to use as pasture. The kinds of pasture plants that will grow on this soil are limited because of the seasonal high water table. Overgrazing or grazing when the soil is too moist increases soil compaction and reduces yields. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by the careful planting of vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the slow or very slow permeability. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings with or without basements because of wetness and the high shrink-swell potential. The problem of wetness can be corrected by using fill material to raise the site above the level of wetness. The problem of shrinking and swelling of the soil can be prevented by using coarse fill, such as sand or gravel, under the foundation and by backfilling with a similar coarse material. Tile drains around the foundation and gravity outlets or other dependable outlets also help to overcome wetness and to reduce shrinking and swelling.

This soil is poorly suited to local roads and streets because of low strength, the hazard of frost damage, and the high shrink-swell potential. These limitations can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase material also helps offset the low strength of the soil.

This soil is in capability subclass IIw and in woodland suitability subclass 2c.

**OeA—Oesterle sandy loam, 0 to 3 percent slopes.**

This is a nearly level and gently sloping, somewhat poorly drained soil in drainageways. Most areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is brown, mottled sandy loam about 4 inches thick. The subsoil is about 16 inches thick. It is brown, mottled, friable sandy loam in the upper part and brown, mottled, very friable loamy sand in the lower part. The substratum is strong brown, mottled sand in the upper 12 inches and strong brown and light brownish gray, loose gravelly sand in the lower part, to a depth of about 60 inches. In some places, the surface layer is loamy sand. In some small areas, the subsoil is as much as 10 percent gravel.

Included in mapping are small areas of the Minocqua and Rosholt soils. The Minocqua soils are poorly drained. They and the Oesterle soil formed in similar deposits, but the Minocqua soils are in lower positions on the landscape. They are in drainageways and depressions. The Rosholt soils are well drained. They also formed in similar deposits, but they are in slightly higher positions on the landscape. They are on convex ridgetops. In some small areas, there are soils that are similar to the Oesterle soil, except that they have thin loamy strata in the substratum below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the subsoil of this Oesterle soil and very rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is moderate. Natural fertility is low. The soil is slightly acid to strongly acid throughout. The surface layer is friable and is easily tilled within a wide range of moisture content. Unless the soil is drained, root development of most plants is limited because of the seasonal high water table. The response to additions of plant nutrients is limited because of wetness and the low available water capacity.

This soil is used mainly as cropland. In some areas, it is used as pasture or woodland.

If drained, this soil is moderately suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. The suitability for crops can be improved by using open ditches to reduce wetness and

using sprinkler irrigation to counter the low available water capacity. Alfalfa is subject to winterkill by frost heave.

This soil is suited to use as pasture. The kinds of pasture plants that can be grown on this soil are limited because of the seasonal high water table. The low available water capacity limits yields in most seasons. Overgrazing or grazing when the soil is wet damages the vegetative cover. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Planting the seedlings on prepared ridges reduces the effect of wetness. Seedling survival can be increased by planting vigorous nursery stock. Trees are generally harvested only when the soil is frozen. Clearcutting or harvesting according to a group-selection method reduces windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the poor filtering capacity of the soil. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings with or without basements because of wetness. This problem can be corrected by installing tile drains around the foundation and providing gravity outlets or other dependable outlets. Using fill material to raise the site above the level of wetness also helps overcome the wetness problem.

This soil is poorly suited to local roads and streets because of the hazard of frost damage. Frost damage can be prevented by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel, and by installing an open ditch or subsurface drainage system to lower the seasonal high water table.

This Oesterle soil is in capability subclass IIw and in woodland suitability subclass 2w.

**OsB—Oshkosh silty clay loam, 2 to 6 percent slopes.** This is a gently sloping, well drained soil on convex ridges and knolls. Most areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown silty clay loam about 10 inches thick. The subsoil is reddish brown, firm clay about 18 inches thick. The substratum to a depth of about 60 inches is reddish brown, firm, calcareous clay. In some places, the surface layer is loam or silt loam.

Included in mapping are small areas of Borth, Neenah, and Tustin soils. Borth and Tustin soils and the Oshkosh soil are in similar positions on the landscape. Borth soils are moderately well drained and have a sandy substratum. Tustin soils are well drained. They have a sandy mantle 20 to 36 inches thick. Neenah soils are

somewhat poorly drained. They and the Oshkosh soil formed in similar deposits, but the Neenah soils are in drainageways, in lower positions on the landscape than those of the Oshkosh soil. In some small areas, the soils are similar to the Oshkosh soil, except that the lower part of the subsoil is mottled. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Oshkosh soil is slow or very slow, and the available water capacity is moderate. The organic matter content in the surface layer is moderate. Natural fertility is medium. The surface layer and the subsoil are medium acid to mildly alkaline, and the substratum is mildly alkaline or moderately alkaline. There are free carbonates in the substratum and commonly in the lower part of the subsoil. The surface layer has enough clay that clods form if the soil is tilled when it is too moist. Root development for most plants is limited because of the density of the subsoil and substratum. The shrink-swell potential of the soil is moderate. The response to additions of plant nutrients is limited because of the moderate available water capacity and poor tilth.

In most areas, this soil is used as cropland. In a few areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. The surface layer is difficult to till without becoming cloddy. It is also subject to crusting, which results in poor emergence of small seeded crops. If the soil is cultivated, erosion is a slight or moderate hazard. Minimum tillage, contour plowing, winter cover crops, and grassed waterways help prevent excessive soil loss. Maintaining the content of organic matter helps prevent erosion, increases the water infiltration rate, and reduces crusting. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth. Crop yields in most seasons are limited because of the moderate available water capacity. This soil is suited to sprinkler irrigation, but the rate of water application must be controlled to prevent runoff and erosion.

The use of this soil as pasture is effective in controlling erosion. Overgrazing or grazing when the soil is wet increases soil compaction, which reduces infiltration and increases runoff. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of the slow or very slow permeability of the soil. This limitation can be overcome by constructing a filtering mound of suitable material.

This soil is moderately suited to use as sites for dwellings with or without basements. The moderate shrink-swell potential is a limitation. This problem can be corrected by using a coarse fill material, such as sand or gravel, under the foundation and backfilling around the foundation with a similar coarse material.

This soil is poorly suited to local roads and streets because of low soil strength. This limitation can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel or by increasing the thickness of the pavement, base, or subbase material.

This Oshkosh soil is in capability subclass 11e and in woodland suitability subclass 2c.

**Pe—Pits, gravel.** These are miscellaneous areas from which sand and gravel have been removed to a depth of at least several feet. Most of the areas are irregular in shape and range from 5 to 40 acres in size.

The pits are mostly in or near areas of the Richford and Rosholt soils. Typically, the material remaining in the bottom of most pits and on the sidewalls is sand and gravel, but in some areas the material includes sandy and loamy glacial till or clayey deposits.

Included in mapping is spoil from the excavated pits, which includes soil that was pushed from the pit area before excavation and piles of other discarded material. Also included are stones or boulders that were too large to crush.

Sand and gravel are still excavated in some pits. Other pits, however, have been abandoned and are overgrown with brush and weeds. Some abandoned pits have filled with water. In reclaiming the areas, land shaping and the addition of suitable topsoil generally are required to establish a vegetative cover.

Onsite investigation is needed to determine the suitability of the pit areas for septic tank absorption fields, for dwellings, and for local roads and streets.

Pits, gravel, have not been assigned to a capability subclass or to a woodland suitability subclass.

#### **PfA—Plainfield loamy sand, 0 to 2 percent slopes.**

This is a nearly level, excessively drained soil on flats. Most areas of this soil are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is dark brown loamy sand about 7 inches thick. The subsoil is brown, very friable sand about 19 inches thick. The substratum to a depth of about 60 inches is strong brown, loose sand. In some places the surface layer is darker than is typical. In some small areas, the subsoil is loamy sand, and in some areas the upper part of the subsoil is as much as 25 percent gravel.

Included in mapping are small areas of the wet substratum phase of Plainfield soils in slightly concave swales, which are slightly lower on the landscape than the positions of this Plainfield soil. The wet substratum

phase is moderately well drained. Also included are small areas of Richford and Tustin soils. Their positions on the landscape are similar to those of the Plainfield soil. Richford soils are somewhat excessively drained and have a sandy loam and loamy sand subsoil. Tustin soils are well drained and have a loamy, silty, and clayey subsoil. Also included are small areas where the soils have strata of sandy loam, loam, or silty clay loam below a depth of 40 inches. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Plainfield soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. The subsoil is slightly acid or medium acid, and the substratum is slightly acid to strongly acid. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as cropland. In some areas it is used as woodland.

This soil is poorly suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, soil blowing is a hazard. This soil is well suited to sprinkler irrigation, and in many areas it is used for irrigated specialty crops, such as potatoes. If the soil is cultivated, soil blowing and the loss of organic matter are the major concerns in management. Minimum tillage, windbreaks, and winter cover crops reduce soil blowing. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture is also effective in controlling soil blowing. Yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This Plainfield soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in pollution of ground water. This soil is suited to dwellings with or without basements and to local roads and streets.

This Plainfield soil is in capability subclass IVs and in woodland suitability subclass 3s.

**PfB—Plainfield loamy sand, 2 to 6 percent slopes.**  
This is a gently sloping, excessively drained soil on

convex ridgetops and knolls. Most areas of this soil are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsoil is brown and strong brown sand about 17 inches thick. It is very friable in the upper part and loose in the lower part. The substratum to a depth of about 60 inches is yellowish brown and brownish yellow, loose sand. In some places, the surface layer is sand, or the subsoil is loamy sand. In some small areas, the upper part of the subsoil is as much as 25 percent gravel.

Included in mapping are small areas of the Richford and Tustin soils. Their positions on the landscape are similar to those of the Plainfield soil. Richford soils are somewhat excessively drained and have a sandy loam and loamy sand subsoil. Tustin soils are well drained and have a loamy, silty, and clayey subsoil. Also included are small areas where the soils have thin strata of sandy loam, loam, or silty clay loam below a depth of 40 inches. In some small areas, soil blowing has caused the loss of all of the surface layer and has exposed infertile sand that contains little or no organic matter. In some areas near the villages of Northland and Big Falls, the Plainfield soil has many boulders and stones on the surface. The included soils make up 5 to 10 percent of this map unit.

Permeability of this Plainfield soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. The subsoil is slightly acid or medium acid, and the substratum is slightly acid to strongly acid. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

This soil is used mainly as cropland. In some areas it is used as woodland. Some areas that were cleared for use as cropland have since been planted to pines for Christmas trees, pulpwood, poles, and lumber.

This Plainfield soil is poorly suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, soil blowing is a hazard and water erosion is a slight hazard. This soil is suited to sprinkler irrigation, and in some areas it is used for irrigated specialty crops, such as potatoes. In those areas, soil blowing, the even distribution of water, the need for fertilizer and herbicides, erosion, and the loss of organic matter are the main concerns in management. Minimum tillage, windbreaks, grassed waterways, contour plowing, and winter cover crops reduce soil blowing and erosion. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture is also effective in controlling soil blowing and erosion. Because of the low available water capacity, yields in most seasons are

limited. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing and erosion. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in pollution of ground water. This soil is suited to dwellings with or without basements and to local roads and streets.

This Plainfield soil is in capability subclass IVs and in woodland suitability subclass 3s.

**PfC—Plainfield loamy sand, 6 to 12 percent slopes.**

This is a sloping or rolling, excessively drained soil on convex side slopes of knolls. Most areas are elongated or irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown loamy sand about 6 inches thick. The subsoil is about 22 inches thick. It is strong brown, loose sand in the upper part and yellowish brown, loose sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, loose sand. In some places, the surface layer is sand, or the subsoil is loamy sand. In some small areas, the upper part of the subsoil is as much as 25 percent gravel.

Included in mapping are small areas of Kranski and Richford soils. These soils are somewhat excessively drained. They and the Plainfield soil are in similar positions on the landscape. The Kranski soils have a loamy sand subsoil and a gravelly loamy sand or loamy sand substratum. The Richford soils have a sandy loam and loamy sand subsoil. In some small areas, there are thin strata of sandy loam, loam, or silty clay loam below a depth of 40 inches. In some small areas, soil blowing has caused the loss of all of the surface layer and has exposed infertile sand that contains little or no organic matter. In some areas of the Plainfield soil near the villages of Northland and Big Falls, there are many boulders and stones on the surface. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Plainfield soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. The subsoil is slightly acid or medium acid, and the substratum is slightly acid to strongly acid. The surface layer is very friable and is easily tilled within a wide range of moisture content, except in included areas that are stony. The response to additions of plant nutrients is limited because of the low available water capacity.

In many areas, this soil was cleared for cropland but is now planted to pines or is idle. In some areas, the soil is used as pasture. This soil generally is not suited to corn or other row crops because of the high susceptibility to soil blowing and water erosion.

This Plainfield soil is poorly suited to grasses and legumes for hay, but the use of this soil as pasture effectively controls soil blowing and erosion. Crop yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing and erosion. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This Plainfield soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in the pollution of ground water.

This soil is moderately suited to use as a site for dwellings with or without basements because of slope. The slope can be reduced or modified by cutting or filling and design. Designing dwellings to conform to the existing slope also helps overcome the problem.

This soil is moderately suited to local roads and streets because of slope. The slope can be modified by cutting and filling to shape the roadway.

This Plainfield soil is in capability subclass VI and in woodland suitability subclass 3s.

**PfD—Plainfield loamy sand, 12 to 30 percent slopes.**

This is a moderately steep and steep, excessively drained soil on convex side slopes of hills. Most areas are long and narrow or irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is very dark brown loamy sand about 4 inches thick. The subsoil is strong brown and yellowish brown, loose sand about 24 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, loose sand. In some places, the surface layer is sand. In some small areas, the upper part of the subsoil is as much as 25 percent gravel.

Included in mapping are small areas of Kranski and Richford soils. The Kranski soils and the Plainfield soil are in similar positions on the landscape. The Kranski soils are somewhat excessively drained and have a loamy sand subsoil and a gravelly loamy sand or loamy sand substratum. The Richford soils are in slightly lower positions on the landscape than the Plainfield soil. They are somewhat excessively drained and have a sandy loam and loamy sand subsoil. In some small areas, soil blowing has caused the loss of all of the surface layer

and has exposed infertile sand that contains little or no organic matter. In some small areas, slopes are less than 12 percent. In some areas of the Plainfield soil near the villages of Northland and Big Falls, there are many boulders and stones on the surface. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Plainfield soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. The subsoil is slightly acid or medium acid, and the substratum is slightly acid to strongly acid. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

This soil is used mainly as woodland. In some areas, it is used for recreational development or as habitat for wildlife.

This soil generally is not suited to crops and pasture because of the steepness of slopes and the low available water capacity.

This soil is suited to trees. Planting trees on the contour helps control erosion, and skid roads should be located where they do not contribute to erosion. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields because of slope and the poor filtering capacity of the soil. This soil is poorly suited to use as sites for dwellings with or without basements because of slope. Where the slope is less than about 20 percent, this limitation can be overcome by cutting and filling to modify the slope or by designing dwellings to conform to the existing slope.

This soil is poorly suited to local roads and streets because of slope. This limitation can be overcome, especially in the less sloping areas, by cutting and filling to shape the roadway or by building the road on the contour or where the soil is not so steep.

This Plainfield soil is in capability subclass VII<sub>2</sub> and in woodland suitability subclass 3r.

**PIB—Plainfield loamy sand, loamy substratum, 2 to 6 percent slopes.** This is a gently sloping, excessively drained soil on convex ridgetops and knolls. Most areas are irregular in shape and range from 5 to 40 acres.

Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsoil is dark brown, very friable sand about 12 inches thick. The substratum in the upper 30 inches is light yellowish brown, loose sand. Below that, to a depth of about 60 inches or more, it is mostly reddish brown, friable loam. In some places the surface layer is darker than is typical. In some small areas, the subsoil is as much as 25 percent gravel. In some small areas, there are strata of silt and fine sand

below a depth of 40 inches. The slope is less than 2 percent in some areas.

Included in mapping are small areas of the Hortonville, Plainfield, and Tilleda soils. Hortonville and Tilleda soils are well drained. Their positions on the landscape are similar to those of this Plainfield soil, but Hortonville and Tilleda soils are more clayey throughout. The Plainfield soil that is included is sandy throughout. In some areas of the Plainfield loamy substratum soil, there are mottles in the upper part of the substratum. In some small areas, soil blowing has caused the loss of all of the surface layer and has exposed infertile sand that contains little or no organic matter. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the subsoil and upper part of the substratum and moderate in the lower part of the substratum. The available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. The subsoil is slightly acid or medium acid. The upper part of the substratum is slightly acid to strongly acid. The lower part of the substratum ranges from slightly acid to mildly alkaline. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as cropland. In some areas it is used as pasture or woodland.

This soil is poorly suited to corn and small grains and to grasses and legumes for hay. The low available water capacity limits yields in most seasons. If this soil is cultivated, soil blowing is a hazard and erosion is a slight hazard. This soil is suited to sprinkler irrigation, and in some areas it is used for irrigated specialty crops, such as potatoes. In those areas, soil blowing, the even distribution of water, the need for fertilizer and herbicides, erosion, and the loss of organic matter are the main concerns in management. Minimum tillage, windbreaks, grassed waterways, and winter cover crops reduce soil blowing. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture is also effective in controlling soil blowing. Because of the low available water capacity, yields in most seasons are limited. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it.

The poor filtering capacity can result in pollution of ground water. This soil is suited to dwellings with or without basements and to local roads and streets.

This Plainfield soil is in capability subclass IVs and in woodland suitability subclass 3s.

**PmA—Plainfield loamy sand, wet substratum, 0 to 3 percent slopes.** This is a nearly level and gently sloping, moderately well drained soil on slightly concave swales and flats. Most areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 9 inches thick. The subsoil is about 17 inches thick. It is brown, very friable sand in the upper part and strong brown, very friable sand in the lower part. The substratum to a depth of about 60 inches is strong brown, loose sand that is mottled in the lower 10 inches. In some places, the surface layer and upper part of the subsoil are sandy loam.

Included in mapping are small areas of Meehan soils and areas of Plainfield soils that are excessively drained and do not have a wet substratum. All of the Plainfield soils and the Meehan soils formed in similar deposits. The Meehan soils are somewhat poorly drained. They are in drainageways, which are slightly lower on the landscape than the positions of the wet substratum Plainfield soil. The excessively drained Plainfield soils are in higher positions. In some small areas of the wet substratum Plainfield soil, there are thin strata of sandy loam, loam, or silty clay loam below a depth of 40 inches. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Plainfield soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. Reaction is medium acid or slightly acid throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients in the soil is limited by the low available water capacity.

This soil is used mainly as cropland. In some areas it is used as woodland or pasture.

This soil is poorly suited to corn and small grains and to grasses and legumes for hay. Yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, soil blowing is a hazard. This soil is well suited to sprinkler irrigation, and in some areas it is used for specialty crops, such as potatoes. In those areas, soil blowing and loss of organic matter are the major concerns in management. Minimum tillage, windbreaks, and winter cover crops reduce soil blowing. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture is also effective in controlling soil blowing. Yields in most seasons are limited because of the low available water capacity.

Overgrazing causes the loss of vegetative cover and results in soil blowing. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in the pollution of ground water. Wetness also limits the use of this soil for septic tank absorption fields; the field can be installed in a filtering mound of suitable borrow material. This soil is suited to dwellings without basements. Because of wetness the soil is only moderately suited to dwellings with basements. Tile drains around the foundation and a gravity outlet or other dependable outlet can correct the wet condition. Constructing basements above the wetness level also corrects this problem. This soil is suited to local roads and streets.

This Plainfield soil is in capability subclass IVs and in woodland suitability subclass 3s.

**Pt—Poy clay loam.** This is a nearly level, poorly drained soil in depressions. It is subject to ponding. Most areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is very dark gray clay loam about 10 inches thick. The subsoil is dark gray and gray, mottled, firm clay about 17 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled, loose sand. In some places, the surface layer is silty clay or silt loam. In some small areas, the subsoil is redder than is typical. In some small areas, there are free carbonates in the lower part of the subsoil.

Included in mapping are small areas of Cathro, Markey, Menasha, and Roscommon soils. The Cathro soils are in slightly lower positions on the landscape than the Poy soil. They formed in 16 to 51 inches of muck. They are very poorly drained. The Menasha soils are poorly drained; they and the Poy soil are in similar positions on the landscape. They are clayey throughout. The Roscommon soils are poorly drained and are sandy throughout. They are in depressions and broad drainageways. Also included are small areas of soils that have a muck surface layer as much as 12 inches thick. In some small areas, the Poy soil has thin strata of silt and very fine sand in the substratum. The included soils make up 5 to 15 percent of the map unit.

Permeability is slow or very slow in the subsoil of this Poy soil and rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is high. Natural fertility is high. The subsoil is neutral or mildly alkaline, and the substratum is neutral to moderately alkaline. The surface layer is firm and

contains enough clay that clods form if the soil is tilled when it is too moist. Root development of most plants is limited because of the seasonal high water table and the density of the subsoil. The shrink-swell potential is high in the subsoil. The response to additions of plant nutrients is limited because of wetness and poor tilth.

In many areas, this soil has been drained and is used as cropland. In some areas, it is used as pasture, woodland, or habitat for wildlife.

If drained and protected from ponding, this soil is suited to corn and small grains. Alfalfa is subject to winterkill by frost heave. In some areas of this soil, the growing season is short because cold air drains into the depressions. Planting early-maturing corn varieties or cutting the corn for silage helps to overcome the frost hazard.

Unless it is drained, this soil is poorly suited to use as pasture. Overgrazing or grazing when the soil is wet causes serious surface compaction and poor tilth. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees, but soil wetness is a problem. If natural regeneration is unreliable seedlings should be planted either by hand or machine on prepared ridges. Planting vigorous nursery stock is essential to minimize seedling mortality. Harvesting generally is done only when the soil is frozen. Harvesting by clearcutting or by an area-selection method helps reduce windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields or as sites for dwellings mainly because of ponding, the slow or very slow permeability, and the high shrink-swell potential. Because these limitations are difficult to overcome, the selection of a more favorable site should be considered.

This soil is poorly suited to local roads and streets because of low soil strength, ponding, and the hazard of frost damage. The limitations of low strength and frost damage can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. The problem of ponding can be corrected by using fill material to raise the road above the ponding level and by installing equalizing culverts to prevent road damage. Surface water can be removed by culverts and side ditches.

This Poy soil is in capability subclass IIw, drained, and in woodland suitability subclass 1w.

#### **RfA—Richford loamy sand, 0 to 2 percent slopes.**

This is a nearly level, somewhat excessively drained soil on flats. Most areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown loamy sand about 8 inches thick. The subsurface layer is yellowish brown loamy sand about 13 inches thick. The subsoil is dark brown and is about 13 inches thick. It is very friable sandy loam in the upper part and very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand. In some places, the surface layer is darker than is typical. In some small areas, the subsoil is as much as 20 percent gravel.

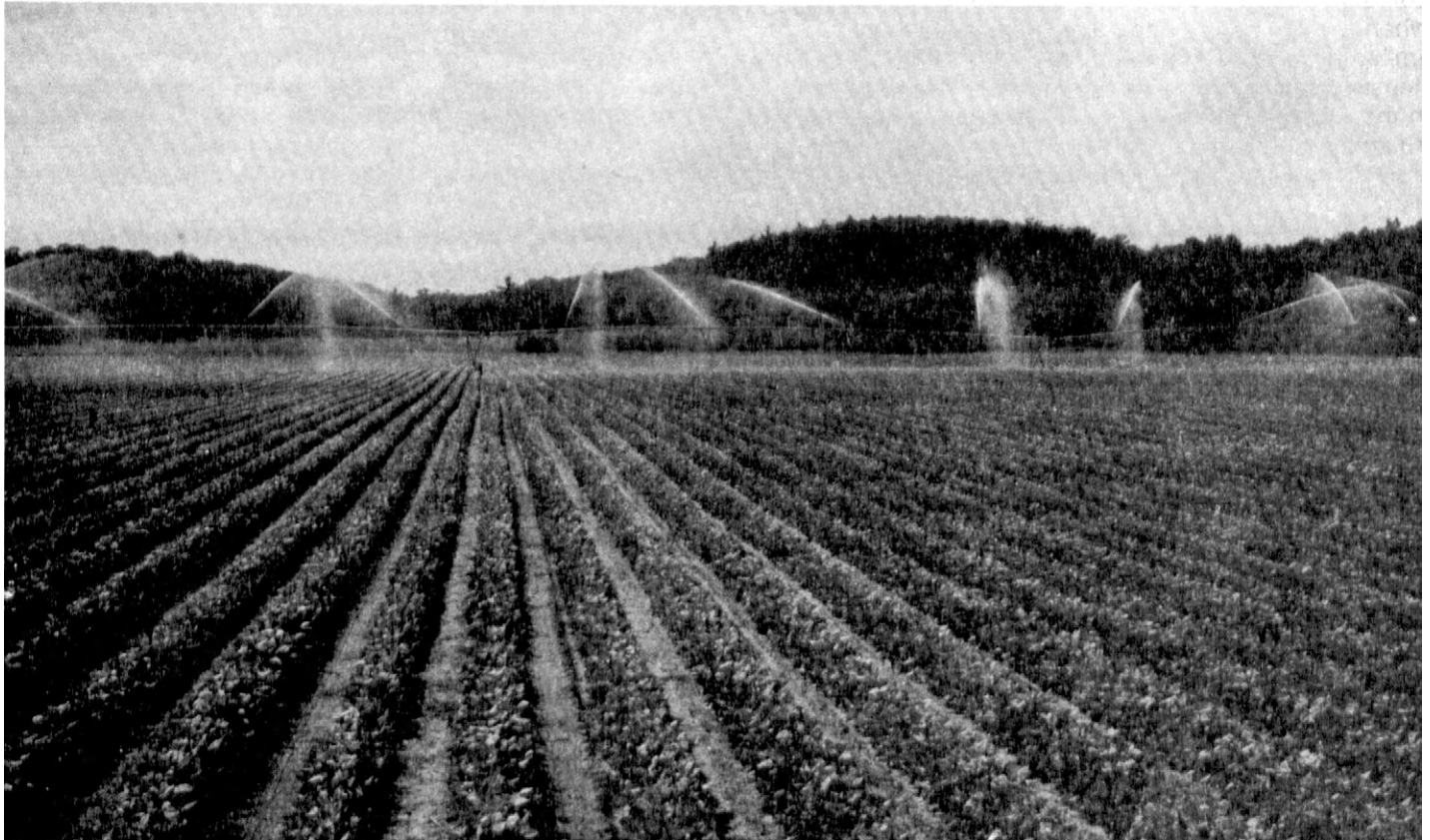
Included in mapping are small areas of Plainfield and Rosholt soils. They and the Richford soil are in similar positions on the landscape. The Plainfield soils are excessively drained. They are sandy throughout. The Rosholt soils are well drained and have a sandy loam surface layer and subsurface layer. In some small areas, the Richford soil has thin strata of silt or very fine sand in the substratum below a depth of 40 inches. In some small areas, the soils are similar to the Richford soil except that they have yellowish brown mottles in the substratum. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the subsoil of the Richford soil and rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. Reaction is slightly acid or medium acid in the surface layer and subsoil and slightly acid or neutral in the substratum. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland or for recreational development.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, soil blowing is a hazard. This soil is well suited to irrigated specialty crops, such as potatoes, and in many areas the soil is used for those crops (fig. 6). On irrigated cropland, the main concerns in management are controlling soil blowing and maintaining the content of organic matter. Minimum tillage, windbreaks, and winter cover crops reduce soil blowing. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture effectively controls soil blowing. Pasture yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.



**Figure 6.—An area of Richford loamy sand, 0 to 2 percent slopes. The crop is snap beans and is irrigated by a center pivot system.**

This Richford soil is suited to trees. Seedling survival can be increased by the careful planting of vigorous nursery stock. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in pollution of ground water. This soil is suited to use as sites for dwellings with or without basements and to local roads and streets.

This Richford soil is in capability subclass IIIs and in woodland suitability subclass 3s.

**RfB—Richford loamy sand, 2 to 6 percent slopes.**

This is a gently sloping, somewhat excessively drained soil on convex ridgetops and knolls. Most areas of this soil are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark brown loamy sand about 7 inches thick. The subsurface layer is brown

loamy sand about 14 inches thick. The subsoil is about 17 inches thick. It is brown, very friable sandy loam in the upper part and brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand. In some places the surface layer is darker than is typical. In some areas, gravel makes up as much as 20 percent of the subsurface layer and the subsoil.

Included with this Richford soil in mapping are small areas of Kranski, Plainfield, and Rosholt soils. The Richford soil and the Kranski, Plainfield, and Rosholt soils are in similar positions on the landscape. Kranski soils are somewhat excessively drained and have a gravelly loamy sand or loamy sand substratum. Plainfield soils are excessively drained and are sandy throughout. Rosholt soils are well drained and have a sandy loam surface and subsurface layer. In some small areas, the Richford soil has thin strata of silt or very fine sand in the substratum below a depth of 40 inches. In some areas of this Richford soil near the villages of Northland and Big Falls, there are many boulders and stones on the surface. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the subsoil and rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. Reaction is slightly acid or medium acid down to the substratum and slightly acid or neutral in the substratum. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

Most areas of this soil are used as cropland. Some areas are used as pasture or woodland or for recreational development.

This Richford soil is suited to corn and small grains and to grasses and legumes for hay. Yields in most seasons are limited because of the low available water capacity. If cultivated, this soil is subject to soil blowing, and erosion is a slight or moderate hazard. This soil is suited to irrigated specialty crops, such as potatoes. If the soil is used for irrigated specialty crops, soil blowing, the even distribution of water, the use of fertilizer and herbicides, erosion, and the loss of organic matter are the main concerns in management. Minimum tillage, windbreaks, grassed waterways, contour plowing, and winter cover crops reduce soil blowing and erosion. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing. In many areas, the slope is long enough and uniform enough for contour cropping.

Using this soil as pasture is also effective in controlling soil blowing and erosion. Yields of pasture plants in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing and erosion. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by the careful planting of vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

If this soil is used for septic tank absorption systems, the effluent is readily absorbed but not adequately filtered. The poor filtering capacity of this soil can result in the pollution of ground water. This soil is suited to dwellings with or without basements and to local roads and streets.

This soil is in capability subclass IIIs and in woodland suitability subclass 3s.

#### **RfC—Richford loamy sand, 6 to 12 percent slopes.**

This is a sloping, somewhat excessively drained soil on convex side slopes of ridges and knolls. Most areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is dark brown loamy sand about 7 inches thick. The subsurface layer is yellowish

brown loamy sand about 12 inches thick. The subsoil is about 14 inches thick. It is very dark brown, very friable sandy loam in the upper part and dark brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is strong brown and yellowish brown, loose sand. In some places, as much as 5 inches of the surface layer has been lost because of soil blowing and erosion. In some small areas, the subsoil is as much as 20 percent gravel.

Included in mapping are small areas of Kranski, Plainfield, and Rosholt soils. They and the Richford soil are in similar positions on the landscape. The Kranski soils are somewhat excessively drained. They have a gravelly loamy sand or loamy sand substratum. The Plainfield soils are excessively drained. They are sandy throughout. The Rosholt soils are well drained. They have a sandy loam surface and subsurface layer. In some small areas, the Richford soil has thin bands of loam, silt, or very fine sand in the substratum below a depth of 40 inches. In some areas of the Richford soil near the villages of Northland and Big Falls, there are many boulders and stones on the surface. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the subsoil of this Richford soil and rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. The surface layer and the subsoil are slightly acid or medium acid. The substratum is slightly acid or neutral. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

This soil is used mainly as cropland. In some areas, it is used as pasture or woodland or for recreational development.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, erosion is a moderate hazard, and the soil is subject to soil blowing. Minimum tillage, windbreaks, grassed waterways, and winter cover crops reduce erosion and soil blowing. In some areas, the slope is long enough and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material helps maintain fertility and reduce soil blowing.

The use of this soil as pasture effectively controls erosion and soil blowing. Pasture yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in erosion and soil blowing. Fertilization, renovation, and rotational grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by the careful planting of vigorous nursery

stock. Competing vegetation, which interferes with natural vegetation following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in the pollution of ground water.

This soil is moderately suited to use as sites for dwellings with or without basements. Slope is a limitation. It can be modified by cutting and filling or the dwelling can be designed to conform to the existing slope by use of retaining walls or columns.

This soil is only moderately suited to local roads and streets because of slope. This limitation can be overcome by cutting and filling to shape the roadway.

This soil is in capability subclass IIIe and in woodland suitability subclass 3s.

**Rm—Roscommon loamy sand.** This is a nearly level, poorly drained soil in depressions and broad drainageways. It is subject to ponding. Most areas are elongated and range from 5 to 50 acres in size.

Typically, the surface layer is black loamy sand about 9 inches thick. The substratum to a depth of about 60 inches is grayish brown and dark gray, loose sand. It is mottled in the upper part. In some places, the upper part of the substratum is as much as 20 percent gravel.

Included in mapping are small areas of Cathro, Markey, Meehan, and Minocqua soils. Cathro and Markey soils formed in 16 to 51 inches of muck. They are in depressions that are lower on the landscape than the areas of the Roscommon soil. They are very poorly drained soils. Meehan soils and the Roscommon soil formed in similar deposits, but the Meehan soils are in slightly higher positions on the landscape. They are in drainageways. Meehan soils are somewhat poorly drained. Minocqua soils and the Roscommon soil are in similar positions on the landscape. The Minocqua soils are poorly drained and have a loamy sand and sandy loam subsoil. Also included are small areas of a soil that is similar to the Roscommon soil except that it has thin bands of silt, very fine sand, or loam in the substratum below a depth of 40 inches. In some small areas, the soils have a muck surface layer that is as much as 12 inches thick. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Roscommon soil is rapid. The available water capacity is low. The organic matter content in the surface layer is high. Natural fertility is low. This soil is slightly acid to mildly alkaline throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. Unless the soil is drained, root development of most plants is limited because of the seasonal high water table. The response to additions of plant nutrients is limited because of the wetness and the low available water capacity.

In most areas this soil is used as pasture, woodland, or habitat for wildlife. In some areas, the soil is used as cropland.

Unless it is drained, this soil is poorly suited to corn and small grains and to grasses and legumes for hay. If the soil is drained and cultivated, soil blowing is a hazard. Crop yields in most seasons are limited because of the low available water capacity.

This soil is poorly suited to use as pasture unless it is drained. Yields in most seasons are limited because of the low available water capacity. Overgrazing or grazing when the soil is wet damages the vegetative cover. If the soil is adequately drained, deep-rooting pasture plants, such as alfalfa, produce the highest yields. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is poorly suited to trees. Growth is so slow and form so poor that trees are barely merchantable. Because of wetness, seedlings generally should be planted either by hand or machine on prepared ridges if natural regeneration is unreliable. Planting vigorous nursery stock is essential to minimize seedling mortality. Harvesting generally is done only when the soil is frozen. Harvesting by clearcutting or by an area-selection method reduces windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields or as sites for dwellings because of ponding and the poor filtering capacity of the soil. Because these limitations are difficult to overcome, the selection of a more favorable site should be considered.

This soil is poorly suited to local roads and streets because of ponding. Fill material can be used to raise the road above the ponding level. Equalizing culverts help prevent damage to the road. Surface water can be removed by culverts and side ditches.

This soil is in capability subclass VIw, undrained, and in woodland suitability subclass 4w.

**RoA—Rosholt sandy loam, 0 to 2 percent slopes.** This is a nearly level, well drained soil on flats. Most areas are irregular in shape and range from 10 to 60 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 6 inches thick. The subsurface layer is yellowish brown sandy loam about 6 inches thick. The subsoil is about 27 inches thick. It is dark brown, very friable sandy loam in the upper part; dark brown, friable sandy loam in the middle part; and dark brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose, stratified sand and gravel. In some places, the surface layer is darker than is typical. In some small areas, the

upper part of the subsoil is as much as 20 percent gravel.

Included in mapping are small areas of Oesterle and Richford soils. The Oesterle soils and the Rosholt soil formed in similar deposits, but the Oesterle soils are in lower positions on the landscape. They are in drainageways. Oesterle soils are somewhat poorly drained. The Richford soils and the Rosholt soil are in similar positions on the landscape. The Richford soils are somewhat excessively drained and have a loamy sand surface and subsurface layer. Also included are small areas of a soil that is similar to the Rosholt soil except that it has mottles in the upper part of the substratum. In some small areas, the Rosholt soil has thin strata of loam, silt, silt loam, or very fine sand in the substratum below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the subsoil of the Rosholt soil and very rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is moderately low. Natural fertility is low. The soil is slightly acid to strongly acid throughout. The surface layer is friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, soil blowing is a hazard. This soil is well suited to irrigated specialty crops, such as potatoes. On irrigated cropland, the main concerns in management are controlling soil blowing and maintaining the content of organic matter. Minimum tillage, windbreaks, and winter cover crops reduce soil blowing. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture effectively controls soil blowing. Pasture yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in pollution of ground water.

This soil is suited to use as sites for dwellings with or without basements. This soil is moderately suited to local roads and streets. Frost damage is a hazard, but it can be prevented by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel.

This Rosholt soil is in capability subclass II<sub>s</sub> and in woodland suitability subclass 2<sub>o</sub>.

#### **RoB—Rosholt sandy loam, 2 to 6 percent slopes.**

This is a gently sloping, well drained soil on convex ridgetops and knolls. Most areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsurface layer is mainly brown sandy loam and is about 11 inches thick. The subsoil is about 17 inches thick. It is dark brown, friable loam in the upper part; dark brown, friable sandy loam in the middle part; and brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, loose, stratified sand and gravel. In some places, as much as 5 inches of the surface layer has been lost through erosion. Also, in some small areas the upper part of the subsoil is as much as 20 percent gravel.

Included in mapping are small areas of Kennan and Richford soils. These soils and the Rosholt soil are in similar positions on the landscape. The Kennan soils are bouldery and are well drained. They have a sandy loam or loamy sand substratum. The Richford soils are somewhat excessively drained. They have a loamy sand surface and subsurface layer. In some small areas, the Rosholt soil has thin strata of loam, silt, or very fine sand in the substratum below a depth of 40 inches. In some areas, the Rosholt soil formed in pitted outwash. These areas have depressions that have steep side slopes (fig. 7). In some areas of the Rosholt soil near the villages of Northland and Big Falls, there are many boulders and stones on the surface. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the subsoil of the Rosholt soil and very rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is moderately low. Natural fertility is low. The soil is slightly acid to strongly acid throughout. The surface layer is friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, it is subject to soil blowing and erosion is a slight or moderate hazard. This soil is also suited to irrigated specialty crops, such as



Figure 7.—Rosholt sandy loam, 2 to 6 percent slopes, formed in pitted outwash in some areas. Depressions are common in those areas.

potatoes, but the application of water must be controlled to prevent runoff and erosion. On irrigated cropland the major concerns in management are soil blowing, erosion, the even distribution of water, the need for fertilizer and herbicides, and the loss of organic matter. Minimum tillage, grassed waterways, windbreaks, and winter cover crops reduce soil blowing. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing. Grassed waterways and diversions reduce erosion. In many areas, the slope is long enough and uniform enough for contour cropping.

The use of this soil as pasture effectively controls soil blowing and erosion. Yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it.

The poor filtering capacity can result in pollution of ground water.

This soil is suited to use as sites for dwellings with or without basements.

This soil is moderately suited to local roads and streets. Frost damage is a hazard, but it can be prevented by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel.

This Rosholt soil is in capability subclass 11e and in woodland suitability subclass 2o.

#### **RoC—Rosholt sandy loam, 6 to 12 percent slopes.**

This is a sloping, well drained soil on convex side slopes of ridges and knolls. Most areas are elongated or irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is mostly brown sandy loam and is about 5 inches thick. The subsoil is about 23 inches thick. It is mostly dark brown, friable sandy loam in the upper part; dark brown, friable sandy loam and loamy sand in the lower part. The substratum to a depth of about 60 inches is dark yellowish brown and dark brown, loose, stratified sand and gravel. In some places, as much as 4 inches of the

surface layer has been lost through erosion. In some small areas, the subsoil is as much as 20 percent gravel.

Included in mapping are small areas of Kennan and Richford soils. These soils and the Rosholt soil are in similar positions on the landscape. The Kennan soils are bouldery and are well drained. They have a sandy loam or loamy sand substratum. The Richford soils are somewhat excessively drained. They have a loamy sand surface and subsurface layer. In some small areas, the Rosholt soil has thin strata of loam, silt, silt loam, or very fine sand in the substratum below a depth of 40 inches. In some areas of the Rosholt soil near the villages of Northland and Big Falls, there are many boulders and stones on the surface. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the subsoil of the Rosholt soil and very rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is moderately low. Natural fertility is low. This soil is slightly acid to strongly acid throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In many areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, it is subject to soil blowing and erosion is a moderate hazard. Minimum tillage, grassed waterways, winter cover crops, and windbreaks reduce erosion and soil blowing. In some areas, the slope is long enough and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture effectively controls erosion and soil blowing. Pasture yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This Rosholt soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in the pollution of ground water.

Because of the slope, this soil is only moderately suited to use as sites for dwellings with or without basements. The slope can be modified by cutting and

filling, or dwellings can be designed to conform to the existing slope by use of retaining walls or columns.

This soil is moderately suited to local roads and streets because of slope and the hazard of frost damage. The limitation of slope can be overcome by cutting and filling to shape the roadway. Frost damage can be prevented by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel.

This Rosholt soil is in capability subclass IIIe and in woodland suitability subclass 2o.

**RoD—Rosholt sandy loam, 12 to 20 percent slopes.** This is a moderately steep, well drained soil on convex side slopes of hills. Most areas are elongated or irregular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 4 inches thick. The subsurface layer is mostly yellowish brown sandy loam about 5 inches thick. The subsoil is about 21 inches thick. It is mostly dark brown, friable sandy loam in the upper part and dark brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, loose, stratified sand and gravel. In some places, gravel makes up as much as 20 percent of the subsoil.

Included in mapping are small areas of Elderon and Kennan soils. The Elderon soils are on the crest of convex slopes. They are stony and have more sand and gravel in the solum than the Rosholt soil. They are somewhat excessively drained. Kennan soils and the Rosholt soil are in similar positions on the landscape. The Kennan soils are bouldery and are well drained. Unlike the Rosholt soil, they have a sandy loam or loamy sand substratum. In some small areas, the Rosholt soil has thin strata of loam, silt loam, or very fine sand in the substratum below a depth of 40 inches. In some small areas, the slope is more than 20 percent. In some areas of the Rosholt soil near the villages of Northland and Big Falls, there are many boulders and stones on the surface. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderately rapid in the subsoil and very rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is moderately low. Natural fertility is low. This soil is slightly acid to strongly acid throughout. The surface layer is friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as woodland. In some areas, it is used as pasture.

This soil is poorly suited to row crops. It is suited to hay, but yields in most seasons are limited because of the low available water capacity. If the soil is cultivated,

erosion is a severe hazard. In most areas, slopes are too short for contour cropping.

The use of this soil as pasture effectively controls erosion. Pasture yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This Rosholt soil is suited to trees. Soil related problems in forest management are associated with steepness of slope and plant competition following harvest. Planting trees on the contour minimizes erosion. Skid roads should be located where they do not contribute to erosion. Seedling survival on the steeper slopes that face south or west can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural vegetation following harvest, can be controlled by herbicides or by mechanical removal. Skidding exposes sufficient mineral soil to allow adequate natural regeneration.

This soil generally is not suited to use as septic tank absorption fields because of the poor filtering capacity and slope. This soil is poorly suited to use as sites for dwellings with or without basements because of slope. Slopes, however, can be modified by cutting or cutting and filling. Also, dwellings can be designed to conform to the slope. Retaining walls or columns can be worked into the design. This soil is poorly suited to local roads and streets because of slope. This problem can be corrected by cutting and filling to shape the roadway.

This Rosholt soil is in capability subclass IVe and in woodland suitability subclass 2r.

**RrB—Rosholt-Rock outcrop complex, 2 to 10 percent slopes.** This complex consists of gently sloping and sloping, well drained Rosholt soil on convex ridges and knolls and areas of exposed granite bedrock. Most areas are irregular in shape and range from 5 to 80 acres in size.

The Rosholt soil makes up 40 to 50 percent of the complex, and areas of granite outcrops make up 35 to 45 percent. The Rosholt soil and the areas of outcrops are so intricately mixed that it was not practical to map them separately (fig. 8).

Typically, the Rosholt soil has a surface layer of very dark grayish brown sandy loam about 3 inches thick. The subsurface layer is mostly brown sandy loam about 15 inches thick. The subsoil is about 17 inches thick. It is dark brown, friable loam in the upper part; dark brown, friable sandy loam in the middle part; and brown, very friable loamy sand in the lower part. The substratum to a depth of about 60 inches is light yellowish brown, loose, stratified sand and gravel.

Rock outcrop consists of areas of exposed granite bedrock. The outcroppings are crevassed in the upper part but are solid at a shallow depth.

Included in mapping are small areas of Oesterle soils. Oesterle soils and the Rosholt soil formed in similar deposits. Oesterle soils, however, are in drainageways, and they are somewhat poorly drained. In some small areas, the depth to granite bedrock is as little as 6 inches. The included soils make up 5 to 15 percent of the complex.

Permeability is moderately rapid in the subsoil of the Rosholt soil and very rapid in the substratum. The available water capacity is low. The organic matter content in the surface layer is moderately low. Natural fertility is low. The Rosholt soil is slightly acid to strongly acid throughout. The surface layer of the Rosholt soil is friable. In some areas, the soil is difficult to till because of rock outcrops. The response to plant nutrients is limited because of the low available water capacity.

Most areas of this complex are used as woodland, as habitat for wildlife, or for recreational development. The Rosholt soil generally is not suited to use as cropland. Cultivation would be very difficult with all but light machinery and hand tools because of the rock outcrops.

The Rosholt soil is suited to use as pasture, but rock outcrops hinder renovation and improvement. Forage yields in most seasons are limited because of the low available water capacity of the soil.

The Rosholt soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal. Trees of commercial quality do not grow in areas of rock outcrops.

The Rosholt soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in pollution of ground water.

The Rosholt soil is suited to use as sites for dwellings with or without basements. However, excavation for dwellings with basements can be very difficult, especially in the areas of included soils that are underlain by granite bedrock.

The Rosholt soil is only moderately suited to local roads and streets because of the hazard of frost damage. This hazard can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. To construct roads and streets in areas of rock outcrops, the bedrock needs to be removed by blasting.

This complex is in capability subclass VIIs. The Rosholt soil is in woodland suitability subclass 2o. Rock outcrop was not assigned to a woodland suitability subclass.

**RsA—Rousseau loamy fine sand, 0 to 3 percent slopes.** This is a nearly level and gently sloping, moderately well drained soil in swales. Most areas are irregular in shape and range from 5 to 40 acres in size.

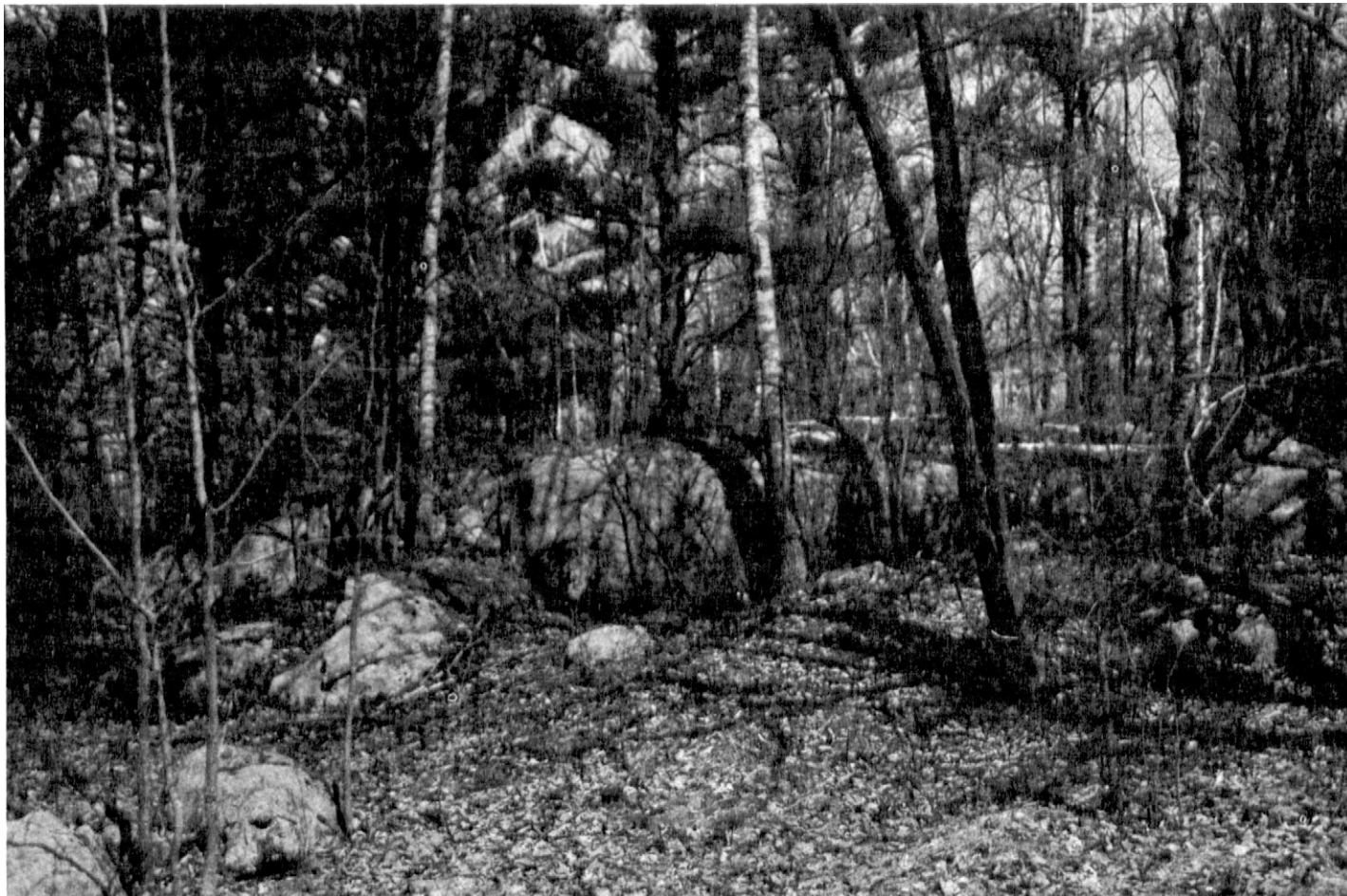


Figure 8.—An area of Rosholt-Rock outcrop complex, 2 to 10 percent slopes. Most areas are used as woodland or habitat for wildlife.

Typically, the surface layer is dark grayish brown loamy fine sand about 8 inches thick. The subsoil is brown and yellowish red, very friable fine sand about 22 inches thick. The substratum to a depth of 60 inches is brown, light brown, and strong brown, mottled, loose fine sand.

Included in mapping are small areas of Shawano and Wainola soils. These soils and the Rousseau soil formed in similar deposits. Shawano soils are excessively drained. They are on convex ridgetops and knolls. Wainola soils are somewhat poorly drained. They are in drainageways. Also included are small areas of soils that have strata of sandy loam, loam, or silty clay loam in the substratum below a depth of 40 inches. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Rousseau soil is rapid, and the available water capacity is low. The content of organic matter in the surface layer is moderately low. Natural fertility is low. This soil is slightly acid or medium acid

throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of wetness and the low available water capacity.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is poorly suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If the soil is cultivated, soil blowing is a hazard. This soil is well suited to sprinkler irrigation. In many areas, the soil is used for specialty crops, such as potatoes. In those areas, soil blowing and loss of organic matter are the major concerns in management. Minimum tillage, windbreaks, and winter cover crops reduce soil blowing. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture effectively controls soil blowing. Pasture yields in most seasons are limited because of the low available water capacity. Overgrazing causes the loss of vegetative cover and results in soil blowing. Fertilization, renovation, and rotation grazing help to keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the poor filtering capacity of the soil. These limitations can be overcome by constructing a filtering mound of suitable material. This soil is suited to use as sites for dwellings without basements. It is moderately suited to use as sites for dwellings with basements because of wetness. The problem of wetness can be corrected by installing tile drainage around the foundation and by providing gravity outlets or other dependable outlets. Constructing the basement above the level of wetness also corrects the problem of wetness. This soil is suited to local roads and streets.

This Rousseau soil is in capability subclass IIIs and in woodland suitability subclass 1s.

**Sb—Seelyeville muck.** This is a nearly level, very poorly drained soil in depressions. It is subject to frequent flooding and ponding of long duration. Most areas are elongated or irregular in shape and range from 5 to 1,000 acres in size.

Typically, black muck extends to a depth of about 60 inches. In some places, there are thin layers of brown woody fragments or peat in the muck.

Included in mapping are small areas of Cathro and Markey soils. These soils and the Seelyeville soil are in similar positions on the landscape. The Cathro and Markey soils, however, are very poorly drained and are underlain by mineral material at a depth of 16 to 51 inches. Also included are small areas where the soils are covered by water most of the year. In some areas that are adjacent to the uplands, as much as 24 inches of mineral material has been deposited on this Seelyeville soil from eroding uplands. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Seelyeville soil is moderately rapid, and the available water capacity is very high. The organic matter content is very high. Natural fertility is low. This soil is medium acid to neutral throughout. The surface layer is very friable, but the use of common farm equipment on this soil is limited because of wetness and the softness of the soil material. Unless the soil is drained, root development of most plants is limited because of the seasonal high water table. The response

to additions of plant nutrients is limited because of wetness.

In most areas, this soil is in native vegetation consisting of water-tolerant trees, marsh grasses, cattails, sedges, reeds, redosier, dogwood, and alder. In a few areas, this soil is drained and is used for corn for silage.

This soil generally is not suited to use as cropland. The hazard of ponding and flooding and a short growing season, which is caused by cold air draining into depressions, limit crop yields and restrict the kinds of crops that can be grown. Soil blowing and subsidence are hazards in drained areas. In undrained areas, the only crop that can be grown is marsh hay, which can be harvested in dry years.

This soil generally is not suited to use as pasture. Organic soils are easily cut by the hooves of cattle; therefore, grazing is restricted to dry periods.

This soil is suited to trees. Wetness and a high water table during the tree planting season limit reforestation to natural regeneration. In harvesting, heavy equipment can be used only when the soil is frozen. Harvesting can be done by clearcutting or by an area-selection method that reduces windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields or as sites for dwellings or for local roads and streets because of flooding, ponding, low stability, and the hazard of frost damage. Because these limitations are difficult to overcome the selection of a more favorable site should be considered.

This Seelyeville soil is in capability subclass VIIw, undrained, and in woodland suitability subclass 3w.

**SfB—Shawano loamy fine sand, 2 to 6 percent slopes.** This is a gently sloping, excessively drained soil on convex ridgetops and knolls. Most areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 7 inches thick. The subsoil is about 22 inches thick. It is strong brown, very friable fine sand in the upper part and brown, loose fine sand in the lower part. The substratum to a depth of about 60 inches is light brown, loose fine sand. In some places, the surface layer is darker than is typical.

Included in mapping are small areas of Tustin soils, Udipsamments, undulating, and Wainola soils. The Tustin soils and this Shawano soil are in similar positions on the landscape. Unlike the Shawano soil, the Tustin soils are well drained and have a loamy and clayey subsoil. Udipsamments, undulating, are in small areas within areas of the Shawano soil. In those areas, the original surface layer was lost through soil blowing, and infertile fine sand that has little or no organic matter is exposed at the surface. Wainola soils and the Shawano soil

formed in similar deposits, but Wainola soils are in lower positions on the landscape. They are in drainageways and are somewhat poorly drained. In some small areas, the Shawano soil has mottles in the substratum or has loamy deposits in the substratum below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Shawano soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. This soil is slightly acid or medium acid throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In many areas, this soil is used as cropland. In some areas, it is used as woodland. Some areas that were cleared for use as cropland are now planted to pines for Christmas trees, pulpwood, poles, and lumber.

This soil is poorly suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, it is subject to soil blowing. This soil is suited to sprinkler irrigation. If the soil is used for irrigated crops, the main concerns in management are soil blowing, the even distribution of water, the need for herbicides and fertilizer, and the loss of organic matter. Minimum tillage, windbreaks, and winter cover crops help reduce soil blowing. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture effectively controls soil blowing. Yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. In eroded areas where all of the surface layer has been removed by soil blowing, seedling survival is low and tree growth is poor. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest in uneroded areas, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it can not adequately filter it. This poor filtering capacity can result in pollution of ground water. This soil is suited to use as sites for dwellings with or without basements and to local roads and streets.

This Shawano soil is in capability subclass IVs and in woodland suitability subclass 2s.

**SfC—Shawano loamy fine sand, 6 to 12 percent slopes.** This is a sloping, excessively drained soil on convex side slopes of ridges and knolls. Most areas are elongated or irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 9 inches thick. The subsoil is about 17 inches thick. It is strong brown, loose fine sand in the upper part and reddish yellow, loose fine sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown, loose fine sand.

Included in mapping are small areas of Richford soils and Udipsamments, undulating. Richford soils and the Shawano soil are in similar positions on the landscape. Richford soils are somewhat excessively drained. They have a sandy loam and loamy sand subsoil. Udipsamments, undulating, are in small areas within areas of the Shawano soil. In those areas, the original surface layer was lost through soil blowing, and infertile fine sand that has little or no organic matter is exposed at the surface. In some small areas, the Shawano soil has loamy deposits in the substratum below a depth of 40 inches. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Shawano soil is rapid. The available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. This soil is slightly acid or medium acid throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In many areas, this soil was cleared for use as cropland but has since been planted to pines or is now idle. In some areas, this soil is used as pasture.

This soil is poorly suited to grasses and legumes for hay. It generally is not suited to corn or other row crops. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, soil blowing is a hazard and erosion is a slight hazard.

The use of this soil for pasture effectively controls soil blowing and erosion. Yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing and erosion. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil can readily absorb the effluent in a septic tank absorption field, but it cannot adequately filter it. The poor filtering capacity can result in pollution of ground water.

This soil is only moderately suited to use as sites for dwellings with or without basements because of slope. The slope can be reduced by cutting or cutting and filling, or dwellings can be built to conform to the existing slope by making use of retaining walls or columns. This soil is moderately suited to local roads and streets because of slope. Cutting and filling can shape the roadway.

This Shawano soil is in capability subclass VI<sub>s</sub> and in woodland suitability subclass 2<sub>s</sub>.

**SfD—Shawano loamy fine sand, 12 to 20 percent slopes.** This is a moderately steep, excessively drained soil on convex side slopes of ridges and hills. Most areas are long and narrow and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 5 inches thick. The subsoil is strong brown, loose fine sand about 23 inches thick. The substratum to a depth of about 60 inches is brown, loose fine sand.

Included in mapping are small areas of Richford soils and Udipsamments, undulating. The Richford soils are in less sloping positions on the landscape. They are on hilltops and in lower concave sloping areas. They are somewhat excessively drained and have a sandy loam and loamy sand subsoil. Udipsamments, undulating, are in small areas within areas of the Shawano soil. In those areas, the original surface layer was lost through soil blowing, and infertile fine sand that has little or no organic matter is exposed at the surface. In some small areas, the slope is less than 12 percent. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Shawano soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is low. This soil is slightly acid or medium acid throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as woodland. In some areas, it is used for recreational development or as habitat for wildlife.

This soil generally is not suited to use as cropland and pasture because of slope and the low available water capacity.

This soil is suited to trees. Planting trees on the contour controls erosion, and skid roads should be located where they do not contribute to erosion. The survival of seedlings can be increased by planting vigorous nursery stock. Vegetation that competes with natural regeneration following harvest can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields because of the poor filtering capacity and the slope. This soil is poorly suited to use as sites

for dwellings with or without basements because of slope. The problem of slope can be corrected by cutting and filling. Also, dwellings can be built to conform to the existing slope by making use of retaining walls or columns.

This soil is poorly suited to local roads and streets because of slope. This problem can be corrected by cutting and filling to shape the roadway.

This Shawano soil is in capability subclass VII<sub>s</sub> and in woodland suitability subclass 2<sub>r</sub>.

**SyA—Symco loam, 0 to 3 percent slopes.** This is a nearly level and gently sloping, somewhat poorly drained soil in slight depressions and in drainageways. Most areas are elongated or irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 18 inches thick. It is dark brown, mottled, firm clay loam in the upper part and reddish brown, mottled, firm clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, mottled, friable, calcareous clay loam. In some places, the surface layer is silt loam or sandy loam.

Included in mapping are small areas of Angelica, Hortonville, and Tilleda soils. The Angelica soils are in lower positions on the landscape than the Symco soil. They are in depressions, and they are poorly drained. The Hortonville and Tilleda soils are in higher positions on the landscape than the Symco soil. They are on convex side slopes and knolls. They are well drained. In some small areas, the Symco soil has strata of sandy loam or loamy sand in the subsoil. In some small areas, there are many stones on the surface. Included are small areas of soils that are similar to the Symco soil except that they have sand and gravel in the substratum below a depth of 40 inches. In some areas of the Symco soil near the village of Readfield, dolomite bedrock is within a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Symco soil is moderately slow, and the available water capacity is high. The organic matter content in the surface layer is high. Natural fertility is high. The surface layer and the subsoil are slightly acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline. There are free carbonates in the substratum. The surface layer is friable and is easily tilled within a wide range of moisture content. Root development of most plants is limited because of the seasonal high water table and the density of the substratum. The response to additions of plant nutrients is limited because of wetness.

In most areas, this soil is used as cropland. In some areas, it is used as pasture, woodland, or habitat for wildlife.

If drained, this Symco soil is suited to corn and small grains and to grasses and legumes for hay. Alfalfa is

subject to winterkill from frost heave and ice sheeting. Minimum tillage and returning crop residue to the soil or regularly adding other organic material help improve tilth and fertility.

This soil is suited to use as pasture. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This Symco soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the moderately slow permeability of the soil. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings with or without basements because of wetness. This problem can be corrected by installing tile drainage around the foundation and by providing gravity outlets or other dependable outlets. Raising the site with fill material also corrects the problem of wetness.

This soil is poorly suited to local roads and streets because of low soil strength and the hazard of frost damage. These limitations can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel, and by installing an open-ditch or subsurface drainage system to lower the seasonal high water table.

This Symco soil is in capability subclass IIw and in woodland suitability subclass 1o.

**TIB—Tilleda loam, 2 to 6 percent slopes.** This is a gently sloping, well drained soil on convex side slopes and knolls. Most areas are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsurface layer is mostly brown loam about 2 inches thick. The subsoil is about 34 inches thick. It is mostly dark brown, friable loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, friable loam. In some places, the surface layer is sandy loam or silt loam. In some small areas, as much as 5 inches of the surface layer has been lost through erosion. In some small areas, there are free carbonates in the substratum.

Included in mapping are small areas of the Kennan and Symco soils. The Kennan soils and this Tilleda soil are in similar positions on the landscape. The Kennan soils are bouldery and well drained. Unlike the Tilleda soil, Kennan soils have a sandy loam subsoil and a sandy loam or loamy sand substratum. The Symco soils are in lower positions on the landscape than the Tilleda

soil. They are in drainageways, and they are somewhat poorly drained. In some small areas, the Tilleda soil has a sandy loam substratum, or it has a loamy sand surface layer that is as much as 12 inches thick. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Tilleda soil is moderate, and the available water capacity is high. The organic matter content in the surface layer is moderate. Natural fertility is medium. Reaction is neutral to medium acid in the surface layer and subsoil. It is neutral or slightly acid in the substratum. The surface layer is friable and is easily tilled within a fairly wide range of moisture content. This soil responds well to additions of plant nutrients, which should be applied in amounts based on soil tests.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. If this soil is cultivated, erosion is a slight or moderate hazard. Minimum tillage, winter cover crops, and grassed waterways help prevent excessive soil losses. In many areas, the slope is long enough and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material helps improve tilth, fertility, and water infiltration.

The use of this soil as pasture effectively controls erosion. Overgrazing or grazing when the soil is wet increases soil compaction, which reduces infiltration and increases runoff. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This Tilleda soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is only moderately suited to use as septic tank absorption fields because of the moderate permeability of the soil. This limitation can be overcome by increasing the size of the absorption field or by constructing a filtering mound of suitable material.

This soil is moderately suited to use as sites for dwellings without basements because of the moderate shrink-swell potential. This limitation can be overcome by covering or replacing the upper part of the soil with a coarse material, such as sand or gravel. This soil is suited to use as sites for dwellings with basements.

This soil is moderately suited to local roads and streets because of the hazard of frost damage and low soil strength. These problems can be corrected by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel.

This soil is in capability subclass IIe and in woodland suitability subclass 1o.

**TIC2—Tilleda loam, 6 to 12 percent slopes, eroded.** This is a sloping, well drained soil on convex side slopes

of ridges and knolls. Most areas are elongated or irregular in shape and range from 5 to 30 acres in size.

In most cultivated areas on the crest of ridges and knolls and on upper side slopes, the original surface layer has been lost through erosion. Typically, the surface layer in these areas is dark brown loam about 6 inches thick. The subsoil is about 37 inches thick. It is mostly brown, friable loam in the upper part and reddish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is reddish brown, firm loam. In some places near the base of slopes and in swales, the surface layer is very dark grayish brown loam. It is 10 to 20 inches thick. In some small areas, the surface layer is sandy loam, silt loam, or clay loam. In some small areas, there are free carbonates in the substratum.

Included in mapping are small areas of Kennan soils. The Kennan soils and this Tilleda soil are in similar positions on the landscape. The Kennan soils are bouldery and well drained. They have a sandy loam subsoil and sandy loam or loamy sand substratum. In some small areas, the slope is more than 12 percent. In some small areas, the Tilleda soil has a sandy loam substratum. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Tilleda soil is moderate, and the available water capacity is high. The organic matter content in the surface layer is moderate. Natural fertility is medium. Reaction is neutral to medium acid in the surface layer and subsoil. It is neutral or slightly acid in the substratum. The surface layer is friable. It can be tilled only within a narrow range of moisture content without clods forming because some subsoil material has been mixed into the plow layer. This soil responds well to additions of plant nutrients, which should be applied in amounts based on soil tests.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. If this soil is cultivated, erosion is a moderate hazard. Following rains, the surface layer is subject to crusting, which restricts the emergence of small seeded crops. Minimum tillage, winter cover crops, and grassed waterways help to prevent excessive soil losses. In some areas, the slope is long enough and uniform enough for contour cropping. Diversions can be used to reduce slope length. Returning crop residue to the soil or regularly adding other organic material helps to improve fertility and water infiltration and reduce crusting.

The use of this soil as pasture effectively controls erosion. Overgrazing or grazing when the soil is wet causes excessive runoff, erosion, surface compaction, and poor tilth. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This Tilleda soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is moderately suited to use as septic tank absorption fields because of slope and moderate permeability. The problem of permeability can be corrected by increasing the size of the absorption field or by constructing a filtering mound of suitable material. The problem of slope can be corrected by cutting and filling or by installing a trench-absorption system on the contour.

This soil is moderately suited to use as sites for dwellings with basements because of slope and for dwellings without basements because of slope and the moderate shrink-swell potential. Shrinking and swelling can be prevented by covering or replacing the upper part of the soil with a coarse material, such as sand or gravel. The slope can be reduced by cutting and filling. Also, retaining walls or columns can be used to conform dwellings to the existing slope.

This soil is moderately suited to local roads and streets because of slope, the hazard of frost damage, and soil strength. The problem of slope can be corrected by cutting and filling to shape the roadway. The problems of frost damage and low strength can be corrected by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase material also helps offset the low strength of this soil.

This Tilleda soil is in capability subclass IIIe and in woodland suitability subclass 1o.

**TuB—Tustin loamy sand, sandy substratum, 2 to 6 percent slopes.** This is a gently sloping, well drained soil on low ridges and knolls. Most areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is about 33 inches thick. It is brown and dark brown, very friable sand in the upper part; reddish brown, firm sandy clay and silty clay loam in the middle part; and reddish brown, firm clay in the lower part. The substratum to a depth of about 60 inches is strong brown, loose sand.

Included in mapping are small areas of Borth, Nebago, and Plainfield soils. Borth and Plainfield soils and the Tustin soil are in similar positions on the landscape. Borth soils are moderately well drained and have a sandy loam or silty clay loam surface layer and a clay subsoil. Plainfield soils are excessively drained and are sandy throughout. Nebago soils and the Tustin soil formed in similar deposits, but Nebago soils are in lower positions on the landscape. They are in drainageways. Also included are small areas where soil blowing has removed the original surface layer, exposing material

that has little or no organic matter. In some small areas, the Tustin soil has mottles in the lower part of the subsoil or has strata of silt and very fine sand in the substratum below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid in the subsurface layer of the Tustin soil, slow in the subsoil, and rapid in the substratum. The available water capacity is low. The organic matter content of the surface layer is low. Natural fertility is low. Reaction is neutral to medium acid in the surface layer and subsoil. It is neutral or slightly acid in the substratum. The surface layer is very friable and is easily tilled within a wide range of moisture content. Root development of most plants is limited because of the density of the subsoil. The shrink-swell potential is high in the subsoil. The response to additions of plant nutrients is limited because of the low available water capacity.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. If this soil is cultivated, erosion is a slight hazard, and the soil is subject to soil blowing. This soil is suited to irrigated specialty crops, such as potatoes. On irrigated cropland, soil blowing, the even distribution of water, the need for fertilizer and herbicides, and the loss of organic matter are the major concerns in management. Minimum tillage, windbreaks, and winter cover crops reduce soil blowing and erosion. Returning crop residue to the soil or regularly adding other organic material helps to maintain fertility and reduce soil blowing.

The use of this soil as pasture effectively controls erosion and soil blowing. Yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in soil blowing and erosion. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Seedling survival can be increased by planting vigorous nursery stock. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of slow permeability in the clayey lower layers. This limitation can be overcome by constructing a filtering mound of suitable material.

This soil is suited to use as sites for dwellings with or without basements. This soil is moderately suited to local roads and streets because of the hazard of frost damage. This limitation can be overcome by increasing the thickness of the sandy upper layer by adding a coarse base material, such as sand or gravel.

This Tustin soil is in capability subclass IIIe and in woodland suitability subclass 3s.

**UdC—Udipsamments, undulating.** These are excessively drained soils that formed in wind-blown sand. They are on short, choppy side slopes. Most areas are irregular in shape and range in size from 5 to 30 acres. The slope ranges from 4 to 12 percent.

Typically, Udipsamments are light brown, loose fine sand to a depth of about 60 inches. In some places the original surface layer is covered by as much as 36 inches of fine sand. In some small areas the slope is more than 12 percent.

Included in mapping are small areas where the seasonal high water table is at a depth of 40 to 60 inches. These areas make up 2 to 5 percent of the map unit.

Permeability is rapid, and the available water capacity is very low. The organic matter content in the surface layer is very low, and natural fertility is low. The loose, dry sand makes the use of tillage equipment difficult. The response to additions of plant nutrients is limited because the available water capacity is very low and because soil blowing is a hazard.

These soils were formerly used as cropland, but most areas are now idle or have been planted to pines.

Udipsamments generally are not suited to crops or pasture. If these soils are cultivated, soil-blowing is a severe hazard. It exposes seeds and damages plants by abrasion. Establishing a vegetative cover on these soils is the main management concern.

The soils are poorly suited to trees because seedling survival is very low and tree growth is slow. The use of vigorous nursery stock can partly offset the poor seedling survival rate. Although production of merchantable wood is marginal, the use of trees to control soil blowing can be effective.

These soils can readily absorb the effluent in a septic tank absorption field but can not adequately filter it. The poor filtering capacity can result in the pollution of ground water. Where the slope is less than 8 percent, the soils are suited to dwellings with basements or without basements and to local roads and streets. Where the slope is more than 8 percent, cuts and fill can be used to reduce the slope, or dwellings can be designed and constructed to conform to the slope. Cuts and fill are needed to provide a suitable grade for local streets and roads.

Udipsamments, undulating, are in capability subclass VIIc. They have not been placed in a woodland suitability subclass.

**Wa—Wainola loamy fine sand.** This is a nearly level, somewhat poorly drained soil in drainageways and on low lying flats. Most areas are elongated or irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The subsoil is brown and strong brown, mottled, very friable fine sand about 16 inches thick. The substratum to a depth of about 60 inches is light gray, brown, and light yellowish brown, mottled, loose fine sand. In some places, the surface layer is sandy loam or the solum and substratum have strata of sand.

Included in mapping are small areas of Nebago, Roscommon, and Rousseau soils. The Nebago soils and this Wainola soil are in similar positions on the landscape. The Nebago soils are somewhat poorly drained. Their subsoil and upper part of the substratum are silty clay. The Roscommon soils are lower on the landscape than the Wainola soil. They are in depressions and broad drainageways. They formed in coarser sand and are poorly drained. The Rousseau soils and the Wainola soil formed in similar deposits, but Rousseau soils are slightly higher on the landscape. They are moderately well drained. In some small areas, the Wainola soil has strata of sandy loam, loam, or silty clay loam in the substratum below a depth of 40 inches. The included soils make up 5 to 10 percent of the map unit.

Permeability of this Wainola soil is rapid, and the available water capacity is low. The organic matter content in the surface layer is moderate. Natural fertility is low. This soil is strongly acid to slightly acid throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. Unless the soil is drained, root development of most plants is limited because of the seasonal high water table. The response to additions of plant nutrients is limited because of wetness and the low available water capacity.

In many areas, this soil is used as cropland. In some areas, it is used as pasture, woodland, or habitat for wildlife.

If drained, this Wainola soil is moderately suited to corn and small grains and to grasses and legumes for hay. If this soil is drained and cultivated, soil blowing is a hazard. Crop yields in most seasons are limited because of the low available water capacity. The suitability for crops can be improved if the soil is drained by open ditches and irrigated by a sprinkler system. This soil is suited to vegetable crops if drained and irrigated.

This soil is moderately suited to use as pasture. The kinds of forage plants that will grow on this soil are limited because of the seasonal high water table. Yields in most seasons are limited because of the low available water capacity. Overgrazing or grazing when the soil is wet damages the vegetative cover. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Planting the seedlings on prepared ridges reduces the effect of wetness. Seedling survival can be increased by planting vigorous nursery

stock. Trees are generally harvested only when the soil is frozen. Clearcutting or harvesting according to a group-selection method reduces windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by use of herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the poor filtering capacity of the soil. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings with or without basements because of wetness. The problem of wetness can be corrected by installing tile drains around the foundation and providing gravity outlets or other dependable outlets. Using fill material to raise the site above the level of wetness also helps.

This soil is moderately suited to local roads and streets because of wetness and the hazard of frost damage. These problems can be corrected by using a coarse base material, such as sand or gravel, to raise the roadbed above the level of wetness, and by installing an open-ditch or subsurface drainage system to lower the seasonal high water table.

This Wainola soil is in capability subclass IIIw and in woodland suitability subclass 1w.

**Wd—Waupaca silt loam.** This is a nearly level, poorly drained soil in depressions and on flood plains. It is subject to ponding and frequent flooding. Most areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The substratum to a depth of about 60 inches is multicolored, very friable, stratified, calcareous silt and very fine sand. The substratum is mottled to a depth of 20 inches. In some places, the surface layer is muck and is as much as 6 inches thick.

Included in mapping are small areas of Cathro, Markey, and Wega soils. Cathro and Markey soils are slightly lower on the landscape than the Waupaca soil. They are in depressions. They formed in 16 to 51 inches of muck. Wega soils and the Waupaca soil formed in similar deposits, but Wega soils are slightly higher on the landscape. They are in drainageways and are somewhat poorly drained. Also included are small areas of a soil that is similar to the Waupaca soils, but it has a sandy or clayey substratum below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Waupaca soil is moderately slow, and the available water capacity is high. The organic matter content in the surface layer is high. Natural fertility is high. This soil is neutral to moderately alkaline throughout. There are free carbonates in the substratum. The surface layer is friable and is easily tilled. Root development of most plants is limited because of the

seasonal high water unless the soil is drained. The response to additions of plant nutrients is limited because of wetness unless the soil is drained.

In most areas, this soil is used as pasture or woodland. In some areas, it is used as farmland. Some areas had been cleared for use as cropland but are no longer used because of wetness and ponding. Most areas of the soil are not suitable for cultivation.

Open ditches are used for drainage where outlets exist. Ditchbanks are subject to sloughing and erosion by the flowing water. If this soil is drained and protected from ponding and flooding, it is suited to corn for silage.

This soil is suited to use as pasture if it is drained. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Because of soil wetness, seedlings should be planted either by hand or machine on prepared ridges if natural regeneration is unreliable. Planting vigorous nursery stock is essential to minimize seedling mortality. Harvesting generally can be done only when the soil is frozen. Harvesting by clearcutting or by an area-selection method help reduce windthrow of the remaining trees. Competing vegetation, which interferes with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil generally is not suited to use as septic tank absorption fields or as sites for dwellings because of ponding, flooding, and the moderately slow permeability. Because these limitations are difficult to overcome, the selection of a more favorable site should be considered.

This soil is poorly suited to local roads and streets because of ponding, flooding, and the hazard of frost damage. These problems can be corrected by using a coarse base and subbase material, such as sand or gravel, to construct the road above the ponding and flooding level and by installing equalizing culverts to prevent road damage. An open-ditch or subsurface drainage system reduces the effects of ponding and flooding.

This Waupaca soil is in capability subclass VIw, undrained, and in woodland suitability subclass 1w.

**WeA—Wega silt loam, 0 to 3 percent slopes.** This is a nearly level and gently sloping, somewhat poorly drained soil in drainageways and on low lying flats. Most areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The substratum is brown and strong brown, mottled, friable silt loam to a depth of 19 inches and light brown and reddish yellow, mottled, very friable, stratified silt and silt loam to a depth of 60 inches.

Included in mapping are small areas of Waupaca and Zurich soils. These soils and the Wega soil formed in similar deposits. Waupaca soils, however, are lower on the landscape. They are in depressions and on flood plains. They are poorly drained. Zurich soils are higher on the landscape than the Wega soil. They are on convex slopes, ridgetops, and knolls. They are moderately well drained. Also included are small areas of soils that are similar to the Wega soil but have thin strata of clay or sand in the substratum below a depth of 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Wega soil is moderately slow, and the available water capacity is high. The organic matter content in the surface layer is moderate. Natural fertility is high. This soil is neutral to moderately alkaline throughout. There are free carbonates in the substratum. The surface layer is friable. It can be tilled only within a narrow range of moisture content without clods forming or without crusting. Root development of most plants is restricted because of the seasonal high water table unless the soil is drained. The response to additions of plant nutrients is limited because of wetness and poor tilth.

In most areas, this soil is used as cropland. In some areas, it is used as pasture, woodland, or habitat for wildlife.

If drained, this soil is suited to corn and small grains and to grasses and legumes for hay. Deep ditches and tile drains are used to drain this soil. Ditchbanks are subject to sloughing and erosion by the flowing water. If tile drainage is installed, silt enters the tile lines unless a suitable filter is used to cover the tile. In some of the lower lying areas of this soil, the growing season is short because cold air drains into the areas. In those areas, corn could be cut for silage, or early-maturing varieties of corn could be grown. Alfalfa is subject to winterkill from frost heave and ice sheeting. The surface layer is subject to crusting, which restricts the emergence of small seeded crops. Minimum tillage and returning crop residue to the soil or adding other organic material improve tilth and fertility and reduce crusting.

This soil is suited to use as pasture. The kinds of pasture plants that will grow on this soil are limited because of the seasonal high water table. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This soil is suited to trees. Planting the seedlings on prepared ridges reduces the effect of wetness. Seedling survival can be increased by planting vigorous nursery stock. Trees are generally harvested only when the soil is frozen. Clearcutting or harvesting according to a group-selection method reduces windthrow of the remaining trees. Competing vegetation, which interferes

with natural regeneration following harvest, can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because of wetness and the moderately slow permeability of the soil. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is poorly suited to use as sites for dwellings with or without basements because of wetness. This problem can be corrected by installing tile drains around the foundation and by providing gravity outlets or other dependable outlets. Using fill material to raise the site above the level of wetness also corrects the problem of wetness.

This soil is poorly suited to local roads and streets because of the hazard of frost damage. This problem can be prevented by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel.

This Wega soil is in capability subclass IIw and in woodland suitability subclass 2w.

**WhB—Whalan loam, 2 to 6 percent slopes.** This is a gently sloping, moderately deep, well drained soil on convex ridgetops and knolls. Most areas are irregular in shape and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is about 28 inches thick. It is reddish brown, friable loam in the upper part; reddish brown, firm clay loam in the middle part; and reddish brown, friable loam in the lower part. Light gray dolomite is below a depth of about 35 inches. In some places, the surface layer is sandy loam.

Included in mapping are small areas of Hortonville and Symco soils. The Hortonville soils and the Whalan soil are in similar positions on the landscape. The Hortonville soils are well drained; they have a fine sandy loam substratum. The Symco soils are lower on the landscape than the Whalan soil. They are in depressions. Symco soils are somewhat poorly drained. They have a clay loam substratum. In some small areas of the Whalan soil, the surface layer and upper part of the subsoil are loamy sand. In some small areas, the Whalan soil is underlain by dolomite within a depth of 20 inches. In some small areas, there are many outcrops of dolomite. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Whalan soil is moderate, and the available water capacity is moderate. The organic matter content in the surface layer is moderately low. Natural fertility is medium. This soil is medium acid to mildly alkaline throughout. The surface layer is friable and is easily tilled within a wide range of moisture content. Root development of deep-rooted plants, such as alfalfa, is limited because of dolomite bedrock. The response to additions of plant nutrients is limited because of the

moderate available water capacity and the limited rooting depth.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the moderate available water capacity. In some areas, the use of machinery on the soil is limited because of the shallow depth to dolomite and the rock outcrops. If this soil is cultivated, erosion is a slight or moderate hazard. Minimum tillage, grassed waterways, and winter cover crops help to prevent excessive soil losses. In many areas, the slope is long enough and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material helps improve fertility and soil moisture.

The use of this soil as pasture effectively controls erosion. Yields in most seasons are limited because of the moderate available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes excessive runoff and erosion. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because it is moderately deep to bedrock. This limitation can be overcome by constructing a filtering mound of suitable material.

This soil is only moderately suited to use as sites for dwellings without basements because of the moderate shrink-swell potential and the shallowness to bedrock. These problems can be corrected by excavating the soil around the foundation and replacing it with coarse material, such as sand or gravel. Excavation of bedrock may be necessary to get sufficient depth for footings. This soil is poorly suited to use as sites for dwellings with basements. Bedrock is a problem, but it can be excavated by blasting or by using a jackhammer or other power-digging equipment. Raising the site with fill material also overcomes this problem.

This soil is poorly suited to local roads and streets because of low soil strength. This limitation can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, and subbase material also helps offset the low soil strength.

This Whalan soil is in capability subclass IIe and in woodland suitability subclass 2o.

**WhC2—Whalan loam, 6 to 12 percent slopes, eroded.** This is a sloping, moderately deep, well drained soil on convex side slopes of ridges and knolls. Most



**Figure 9.—An area of Whalan loam, 6 to 12 percent slopes, eroded. This soil is shallow to dolomite, and dolomite outcrops are common.**

areas are elongated or irregular in shape and range from 5 to 30 acres in size.

In most cultivated areas, on the crest of ridges and knolls and on upper side slopes, the original surface layer has been lost through erosion. Typically, the surface layer in these areas is dark brown loam about 6 inches thick. The subsoil is about 22 inches thick. It is brown, friable loam in the upper part; reddish brown, firm clay loam in the middle part; and reddish brown, friable loam in the lower part. Light gray dolomite is below a depth of about 28 inches. In some places near the base of slopes and in swales, the surface layer is very dark

grayish brown loam. It is 10 to 20 inches thick. In some small areas, the surface layer is fine sandy loam.

Included in mapping are small areas of Hortonville soils. The Hortonville soils and the Whalan soil are in similar positions on the landscape. The Hortonville soils are well drained. They have a fine sandy loam substratum. In some small areas, the Whalan soil is underlain by dolomite within a depth of 20 inches. In some areas, there are outcroppings of dolomite (fig. 9). The included soils make up 5 to 15 percent of the map unit.

Permeability of this Whalan soil is moderate, and the available water capacity is moderate. The organic matter content in the surface layer is low. Natural fertility is medium. This soil is medium acid to mildly alkaline throughout. The surface layer is friable. It can be tilled only within a narrow range of moisture content without clods forming because some subsoil material has been mixed into the plow layer. Root development for deep-rooted plants, such as alfalfa, is limited because of dolomite bedrock. The response to additions of plant nutrients is limited because of the moderate available water capacity.

In most areas, this soil is used as cropland. In some areas, it is used as woodland or pasture.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the moderate available water capacity. In some areas, the use of machinery is limited because of the shallow depth to dolomite and the rock outcrops. If this soil is cultivated, erosion is a moderate hazard. Minimum tillage, grassed waterways, and long rotations consisting of close-growing crops help prevent excessive soil losses. In some areas, the slope is long enough and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material helps improve fertility, water infiltration, and tilth.

The use of this soil as pasture effectively controls erosion. Yields in most seasons are limited because of the moderate available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes excessive runoff and erosion. Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because it is moderately deep to bedrock. This limitation can be overcome by constructing a filtering mound of suitable material.

This soil is only moderately suited to use as sites for dwellings without basements because of slope, moderate shrink-swell potential, and shallowness to bedrock. The problem of slope can be corrected by cutting or cutting and filling to reduce the slope or by designing the dwelling to conform to the existing slopes. The shrinking and swelling of the soil and shallowness to bedrock can be overcome by using coarse fill material, such as sand or gravel, under the foundation and backfilling around the foundation with a similar coarse material. Excavation of bedrock may be necessary to get sufficient depth for footings. This soil is poorly suited to use as sites for dwellings with basements because of the bedrock. The bedrock can be excavated by blasting or

by using a jackhammer or other power-digging equipment. Raising the site with fill material also helps.

This soil is poorly suited to local roads and streets because of low soil strength. This limitation can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase material also helps offset the low strength.

This Whalan soil is in capability subclass IIIe and in woodland suitability subclass 2o.

**WvB—Whalan Variant loamy fine sand, 2 to 6 percent slopes.** This is a gently sloping, moderately deep, well drained soil on convex ridgetops and knolls. Most areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is dark brown loamy fine sand about 11 inches thick. The subsoil is about 13 inches thick. It is reddish yellow and brownish yellow, very friable loamy fine sand in the upper part and reddish brown, firm silty clay loam in the lower part. Light gray dolomite is below a depth of about 24 inches. In some places, the lower part of the subsoil is clay loam.

Included in mapping are small areas of Hortonville, Plainfield, and Symco soils. Hortonville and Plainfield soils and this Whalan Variant soil are in similar positions on the landscape. The Hortonville soils are well drained and have a fine sandy loam substratum. The Plainfield soils are excessively drained and are sandy throughout. Symco soils are lower on the landscape than the Whalan Variant soil. They are in drainageways and are somewhat poorly drained. In some small areas, the Whalan Variant soil is underlain by dolomite within a depth of 20 inches. In some small areas, there are many outcrops or escarpments of dolomite. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Whalan Variant soil is moderate, and the available water capacity is low. The organic matter content in the surface layer is low. Natural fertility is medium. This soil is medium acid to mildly alkaline throughout. The surface layer is very friable and is easily tilled within a wide range of moisture content. Root development for deep-rooted plants, such as alfalfa, is limited because of the dolomite bedrock. The response to additions of plant nutrients is limited because of the low available water capacity and the limited rooting depth.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. Crop yields in most seasons are limited because of the low available water capacity. In some areas, the use of machinery is limited because of the shallow depth to dolomite and the rock outcrops. If this soil is cultivated, erosion is a slight or moderate hazard, and the soil is subject to soil blowing. Minimum tillage, winter cover crops, grassed waterways,

and windbreaks reduce soil blowing and erosion. In some areas, the slope is long enough and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material improves fertility and reduces soil blowing.

The use of this soil as pasture effectively controls erosion and soil blowing. Yields in most seasons are limited because of the low available water capacity. Deep-rooting pasture plants, such as alfalfa, produce the highest yields. Overgrazing causes the loss of vegetative cover and results in erosion and soil blowing.

Fertilization, renovation, and rotation grazing help keep the pasture plants and the soil in good condition.

This soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is poorly suited to use as septic tank absorption fields because it is moderately deep to bedrock. This problem can be corrected by constructing a filtering mound of suitable material.

This soil is moderately suited to use as sites for dwellings without basements because of moderate shrink-swell potential and shallowness to bedrock. These problems can be corrected by using coarse fill, such as sand or gravel, under the foundation and backfilling around the foundation with a similar coarse material. Excavation of bedrock may be necessary to get sufficient depth for footings. This soil is poorly suited to use as sites for dwellings with basements. Bedrock is a problem, but it can be excavated by blasting or by using a jackhammer or other power-digging equipment. Raising the site with fill material also overcomes this problem.

This soil is poorly suited to local roads and streets because of low soil strength. This limitation can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand or gravel. Increasing the thickness of the pavement, base, or subbase material also helps offset the low strength of this soil.

This Whalan Variant soil is in capability subclass III<sub>s</sub> and in woodland suitability subclass 3<sub>s</sub>.

**ZzB—Zurich silt loam, 2 to 6 percent slopes.** This is a gently sloping, moderately well drained soil on convex ridgetops and knolls. Most areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is mostly dark brown, friable silt loam about 13 inches thick. The substratum to a depth of about 60 inches is brown, brownish yellow, and dark brown, mottled, very friable, stratified silt loam and very fine sandy loam. In some places, the surface layer is very fine sandy loam. In some small areas, 3 to 5 inches of the surface layer have been lost because of erosion. In some small areas

the substratum has thin strata of sand or clay below a depth of 40 inches. Also in some small areas, the substratum does not have mottles.

Included in mapping are small areas of Borth, Oshkosh, Tustin, and Wega soils. These soils and the Zurich soil are in similar positions on the landscape. The Borth soils are moderately well drained and have a clay subsoil and sand substratum. The Oshkosh soils are well drained and also have a clay subsoil and sand substratum. The Tustin soils are well drained and have a sandy mantle about 20 to 36 inches thick that is underlain by a loamy, silty, and clayey subsoil and sand substratum. The Wega soils are somewhat poorly drained. They and the Zurich soil formed in similar deposits, but Wega soils are in drainageways, which are lower on the landscape than the positions of the Zurich soil. In some areas of the Zurich soil near the village of Sheridan, a sand and gravel substratum is at a depth of about 40 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability of this Zurich soil is moderate, and the available water capacity is high. The organic matter content in the surface layer is moderate. Natural fertility is high. The surface layer and the subsoil are slightly acid to mildly alkaline, and the substratum is mildly alkaline or moderately alkaline. There are free carbonates in the substratum. The surface layer is very friable. It can be tilled only within a narrow range of moisture content without clods forming or without crusting. This soil responds well to additions of plant nutrients which should be applied in amounts based on soil tests.

In most areas, this soil is used as cropland. In some areas, it is used as pasture or woodland.

This soil is suited to corn and small grains and to grasses and legumes for hay. The seasonal high water table generally is not a problem, except for deep-rooting crops, such as alfalfa. If tile drainage is used, silt and very fine sand enter the tile lines unless a suitable filter is used to cover the tile. If this soil is cultivated, erosion is a slight or moderate hazard. Minimum tillage, winter cover crops, and grassed waterways help to prevent excessive soil losses. In many areas, the slope is long enough and uniform enough for contour cropping. Returning crop residue to the soil or regularly adding other organic material improves fertility and water infiltration.

The use of this soil as pasture effectively controls erosion. Overgrazing or grazing when the soil is wet causes excessive runoff, erosion, and surface compaction. Fertilization, renovation, rotation grazing, and restricted use during wet periods help keep the pasture plants and the soil in good condition.

This Zurich soil is suited to trees. The only soil-related problem in forest management is plant competition, which interferes with natural regeneration following

harvest. The competing vegetation can be controlled by herbicides or by mechanical removal.

This soil is moderately suited to use as septic tank absorption fields because of wetness and the moderate permeability of the soil. These limitations can be overcome by constructing a filtering mound of suitable material.

This soil is moderately suited to use as sites for dwellings without basements because of the moderate shrink-swell potential. This problem can be prevented by covering or replacing the upper part of the soil with a coarse material, such as sand or gravel. This soil is moderately suited to use as sites for dwellings with basements because of wetness. This problem can be

corrected by installing tile drains around the foundation and providing gravity outlets or other dependable outlets. Constructing the basement above the level of wetness also overcomes the problem of wetness.

This soil is poorly suited to local roads and streets because of low soil strength and the hazard of frost damage. These limitations can be overcome by covering or replacing the upper part of the soil with a coarse base material, such as sand and gravel. Increasing the thickness of the pavement, base, or subbase material also helps offset the low strength of this soil.

This Zurich soil is in capability subclass 1Ie and in woodland suitability subclass 2o.



# Prime Farmland

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In this section, prime farmland is defined and discussed, and the prime farmland soils in Waupaca County are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 6 percent.

Soils that have a high water table may qualify as prime farmland soils if the limitation is overcome by drainage. Onsite evaluation is necessary to determine the

effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

About 184,000 acres, or nearly 38 percent of the county, is prime farmland. These areas are scattered throughout the county, but most are in the eastern part, mainly in map units 3 and 5 on the general soil map. Crops grown on this land are mainly corn, oats, and alfalfa.

A recent trend in land use in some parts of the county has been the conversion of some prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are wet, more erodible, droughty, or difficult to cultivate and less productive than prime farmland.

The following map units, or soils, make up prime farmland in Waupaca County. If a soil is considered to be prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Ax	Angelica silt loam (where drained)
BoB	Borth sandy loam, 1 to 4 percent slopes
BrB	Borth silty clay loam, 1 to 4 percent slopes
HnB	Hortonville fine sandy loam, 2 to 6 percent slopes
KbB	Kennan bouldery sandy loam, 2 to 6 percent slopes (where boulders have been removed)
MrB	Military loamy sand, 3 to 8 percent slopes
OeA	Oesterle sandy loam, 0 to 3 percent slopes
RoA	Rosholt sandy loam, 0 to 2 percent slopes
RoB	Rosholt sandy loam, 2 to 6 percent slopes
SyA	Symco loam, 0 to 3 percent slopes
TIB	Tilleda loam, 2 to 6 percent slopes
WeA	Wega silt loam, 0 to 3 percent slopes
WhB	Whalan loam, 2 to 6 percent slopes
ZzB	Zurich silt loam, 2 to 6 percent slopes



# Use and Management of the Soils

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This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and to the environment. Also, it can help prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the suitability and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## Crops and Pasture

Kenneth D. Halverson, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated

yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1978, about 311,000 acres in Waupaca County was in farms, according to the U.S. Census of Agriculture. About 220,800 acres was used as cropland, 16,300 acres as pasture, and 73,700 acres as woodland, and the remainder was in other farm uses.

The potential for increased food production in Waupaca County is fair to good. If proper conservation practices are applied, about 30,000 additional acres can be used for crops. This acreage is now being used as pasture or woodland or is in other farm uses. In addition to the reserve acreage of cropland, the productive capacity of all cropland in the county can be increased by the latest crop production technology.

The acreage in farms has gradually decreased as more land is used for urban development. From 1969 to 1978, farm acreage decreased by about 10,000 acres. This land is now used for parks, roads, and other nonfarm uses.

*Soil erosion* is a the major problem on about two-thirds of the cropland in Waupaca County. If the slope is more than 2 percent, erosion is a hazard.

Soil erosion is damaging for three reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging to soils that have a clayey subsoil, such as Borth and Oshkosh soils. Sandy soils, such as Kranski, Plainfield, and Shawano soils, are damaged because infertile sand that has little or no organic matter is exposed. Erosion also damages soils that have a layer that restricts the depth of the rooting zone; such layers include dolomite bedrock in the Whalan soils and sand and gravel in the Rosholt soils.

Second, soil erosion adversely affects tilth and lowers the water infiltration rate. Erosion generally increases the clay content of the plow layer, which becomes more difficult to till and becomes subject to puddling and crusting. Crusting causes poor seedling emergence and

reduces water infiltration. More water is lost as runoff, and the hazard of erosion is increased.

Third, soil erosion produces sediment. Controlling erosion reduces the amount of sediment entering streams, rivers, and lakes and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Erosion control practices provide a protective surface cover, reduce runoff, and increase the rate of water infiltration. A cropping system that keeps a vegetative cover on the surface for an extended period can hold soil erosion losses to an amount that does not reduce the productivity of the soils. Legumes and grass forage crops in the cropping system reduce erosion and improve tilth for the next crop. Legumes also add nitrogen to the soil.

On some soils in Waupaca County slopes are so short and irregular that contour tillage or terracing is not practical. On these slopes, cropping systems that provide substantial vegetative cover are needed to control erosion. The no-till method of conservation tillage, for example, can be adapted to most of the soils in Waupaca County. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. Delaying plowing until spring is also effective in controlling erosion. Fall plowing leaves the surface layer bare of a protective vegetative cover for an extended period. Winter winds and spring runoff remove an excessive amount of the surface layer if the vegetative cover is plowed under.

Diversions reduce the length of the slope and reduce runoff and erosion. They are most easily put to use on deep, well drained soils that have a uniform slope.

Contour cropping and contour strip cropping are widely used in some parts of the county. They are best adapted to soils that have long, uniform slopes.

*Soil blowing* is a hazard on all of the soils in Waupaca County, especially on the sandy soils, such as Kranski, Plainfield, Richford, Shawano, and Tustin soils. Soil blowing is also a hazard on organic soils that are cultivated, and it can cause severe damage in a few hours if winds are strong. Soils that are smooth, dry, and bare of vegetation or of crop residue are most subject to soil blowing. Maintaining a vegetative cover or leaving crop residue on the surface minimizes soil blowing. Windbreaks are also effective in minimizing soil blowing. Irrigating dry soils requires too long a time to effectively wet the soil.

Information on the design of erosion control practices for each kind of soil in the survey area is available at local offices of the Soil Conservation Service.

*Soil drainage* is the major management need on about one-third of the cropland in Waupaca County.

Unless artificially drained, the somewhat poorly and poorly drained soils are so wet that crops are damaged in most years. These wet soils include Meehan,

Menasha, Minocqua, Nebago, Neenah, Oesterle, Poy, Roscommon, Symco, Wainola, Waupaca, and Wega soils.

Borth, Oshkosh, and Zurich soils have good natural drainage, but they tend to dry out slowly after rains. Water also tends to pond on the lower slopes following heavy rains. Artificial drainage is needed in some areas.

The design of surface and subsurface drainage systems varies with the kind of soil and the site condition. A combination of surface drainage and subsurface drainage is needed in most areas of the poorly drained soils that are used as cropland. Drains must be more closely spaced in soils that have slow permeability than in the more permeable soils. Locating suitable outlets for subsurface drainage is difficult in some areas of poorly drained soils.

Organic soils are also in this group of wet soils. Special drainage systems are needed on these soils to control the depth and the period of drainage. The organic soils oxidize and subside when the pore spaces are drained of water. Lowering the water table to the level required by the crop during the growing season and raising it to the surface during the rest of the year minimizes oxidation and subsidence.

Sandy soils, such as the Meehan, Roscommon, and Wainola soils, have a seasonal wetness problem, generally in the spring. During the growing season the water table drops, and these soils become droughty, consequently, crops undergo severe moisture stress in the latter part of the growing season. For high crop yields, surface drains are needed to remove the excess water in the spring, and the soil must be irrigated to maintain adequate soil moisture during the rest of the growing season.

Drainage also increases the length of the growing season. Soils that are adequately drained can be tilled earlier in the spring, and they reach a temperature that is favorable for plant growth earlier.

Information on drainage design for each kind of soil in the survey area is available at the local offices of the Soil Conservation Service.

*Soil fertility* is naturally low or medium in most of the upland soils in the survey area. Fertility can be improved by applying commercial fertilizer and by choosing a cropping system that adds organic matter to the soil. On dairy farms, a diversified cropping system and applications of manure help maintain the organic matter content. If specialty crops, such as potatoes, are grown, green manure crops are needed to maintain the content of organic matter.

The use of commercial fertilizer increases the yields of most crops. Generally, the subsoil of the mineral soils in the western part of the county has a medium phosphorus level and is low in potassium; and the subsoil of the mineral soils in the eastern part of the county is low in phosphorus and potassium. Most of the soils in the western part of the county naturally range

from slightly acid to strongly acid. Most of the soils in the eastern part of the county are naturally neutral or slightly acid and have an alkaline subsoil. On all soils, additions of lime and fertilizer should be based on soil tests, the need of the crop, and the expected yields. The University of Wisconsin Extension Service can help determine the kind and amount of fertilizer and lime to apply.

*Soil tilth* is an important factor in seedling emergence and the infiltration of water into the soil. Soils that have good tilth are granular and porous. Tilth is affected by the texture of the surface layer and the content of organic matter in the soil. Both of these characteristics are affected by erosion. In the western part of the county, erosion has little effect on tilth because the subsoil is mostly sandy loam or loam. In contrast, in the central and eastern parts of the county, erosion severely affects the tilth of the soils because the subsoil is mostly silty clay loam or clay. Generally, the structure of the surface layer of these soils is weak, and intense rains cause a crust to form on the surface. This crust is hard when dry and nearly impervious to water. It reduces the infiltration of water, increases runoff, and hinders the emergence of small-seeded plants. Regular additions of crop residue and manure help improve soil structure and reduce crust formation.

The somewhat poorly drained and poorly drained soils in the county have a moderately low to high organic matter content and have a dark surface layer. They are less likely to form a crust than are the well drained upland soils that have less organic matter.

*Irrigation* is well suited to the nearly level Plainfield, Richford, Rosholt, Rousseau, and Shawano soils. These soils have a low available water capacity and need additions of water for sustained crop yields. Many areas of these soils are well suited to sprinkler irrigation. These soils have moderately rapid or rapid permeability.

In 1978, approximately 4,000 acres in Waupaca County was irrigated, but more land is now being irrigated. Specialty crops, such as potatoes and snap beans, are grown in most of the irrigated areas. The use of irrigation for common farm crops is gaining in importance in the county as the value of cropland increases.

Irrigation water comes from high-capacity wells or from ground-water ponds. Most areas that are suited to irrigation have an ample supply of water. In addition, Waupaca County has about 25,000 acres of soils that are well suited to irrigation but are now being farmed without irrigation.

Information on irrigation design and amount of acre feet of water needed is available at local offices of the Soil Conservation Service and at the county office of the University of Wisconsin Extension Service.

*Field crops* suited to the area include many crops that are not commonly grown. Corn is the most extensively grown row crop. Grain sorghum, sunflowers, soybeans,

sugar beets, snap beans, cucumbers, sweet corn, and similar row crops can be grown if economic conditions are favorable.

Oats and rye are the common close-growing small crops. Wheat and barley are also grown if economic conditions are favorable. Alfalfa, timothy, red clover, brome grass, fescues, and bluegrass are the common hay crops from which grass and legume seed can also be harvested.

*Special crops* grown commercially in the county are vegetables, small fruits, tree fruits, and nursery plants. Potatoes, sweet corn, cabbage, snap beans, and peas are the most commonly grown vegetables. Many other vegetable crops can be grown under irrigation if economic conditions are favorable.

The nearly 50,000 acres of muck soils in the county may have potential for such specialty crops as mint and cranberries. These soils are the Cathro, Markey, and Seelyeville soils. In most areas, these soils are undrained and are in native vegetation. Drainage and careful crop selection are needed for good production. The growing season between frosts late in spring and early in fall is quite short because of cold air draining into the depressions that these soils are in. These soils are low in natural fertility and are subject to subsidence and soil blowing if drained and cultivated.

Information and suggestions on growing special crops can be obtained from the county office of the University of Wisconsin Extension Service.

*Pasture plants* grown in the county can be separated into two types—rotation pasture and perennial or permanent pasture.

Rotation pastures are areas that are used for cultivated crops in some years and for pasture in one or more years as part of the cropping system. The pasture generally consists of a grass-legume mixture. Perennial pastures are occupied by perennial pasture plants or by self-seeding annuals but more often are a combination of both types. This kind of pasture remains unplowed for many years. Generally soils on slopes of more than 15 percent are used for perennial pasture.

Management practices are similar for both types of pasture. Proper stocking, pasture rotation, timely deferment of grazing, and restricted use during wet periods help keep the soil and the pasture plants in good condition. Renovation of perennial or permanent pasture with high yielding pasture plants, such as brome grass and alfalfa, is desirable if erosion can be controlled. Wet soils need artificial drainage to increase the yield and selection of the pasture plants.

## Yields Per Acre

J. L. Walker, agricultural agent, University of Wisconsin Extension Service, assisted in reviewing the crop yield data.

The average yields per acre that can be expected of the principal crops under a high level of management

are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The capability classification is also shown for each unit.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered (4).

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

### Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (10). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

*Capability classes*, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

*Capability subclasses* are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, II<sub>e</sub>. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in table 5 and in the section "Detailed Soil Map Units."

### Woodland Management and Productivity

George W. Alley, forester, Soil Conservation Service, helped prepare this section.

Forest covered all of Waupaca County before settlement; however, much of the land suitable for farm crops has since been cleared. About 35 percent of the land area remains in commercial forest. Most of this acreage is privately owned, and a small part is held by the forest industry (14).

The most important commercial forest is in map unit 2, which is described in the section "General Soil Map Units". The dominant trees are northern red oak, aspen, and paper birch. Other common species are sugar maple, white ash, and other hardwoods. Pine plantations

are prevalent on the sandy soils of map unit 1. Many pine windbreaks help control soil blowing in this area.

Timber stand cuttings to remove low quality trees can improve the forests of Waupaca County. Livestock should be excluded from some farm woodlots. Many of the older pine plantations are being thinned.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol (woodland suitability) for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: *x*, *w*, *t*, *d*, *c*, *s*, *f*, and *r*.

In table 7, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

*Seedling mortality* ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots

and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

*Trees to plant* are those that are suited to the soils and to commercial wood production.

Additional information about woodland management and productivity can be obtained from the Wisconsin Department of Natural Resources, the local office of the Soil Conservation Service, or the Cooperative Extension Service.

## Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Wisconsin Department of Natural Resources, the Cooperative Extension Service, or from a nursery.

## Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

*Camp areas* require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

*Picnic areas* are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains,

and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

*Paths and trails* for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

*Golf fairways* are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

## Wildlife Habitat

Thomas P. Thrall, biologist, Soil Conservation Service, helped prepare this section.

Wildlife is affected by the kinds of soil and the local management of those soils. Generally, the wildlife population is in balance with the availability of food, cover, and water. Soils directly affect the kind and amount of native plants and cultivated crops. They also affect what can be done to improve the wildlife habitat, such as pond and wetland development and the planting of food and cover plants. Generally, the more varied the kinds of soil in an area, the more mixed the habitat will be.

In the following paragraphs, the six General Soil Map Units are described in terms of wildlife features.

### Map Units 1 and 2

The soils in these map units range from nearly level to steep and are sandy and loamy. The more gently sloping soils are mostly farmed, and the moderately steep and steep soils are mainly in woodland. In about 35 percent of the map units, the soils are in woodland. Corn, oats, and alfalfa are the main crops, but irrigated crops, such as potatoes and snap beans, are also grown. The moderately steep and steep soils in these map units provide the most habitat cover, but the native grasses and shrubs along the border of interspersed lakes, ponds, depressional wetlands, and streams also provide habitat cover.

The diverse kind of habitat in these wildlife areas supports a wide variety of wildlife. The major game animals in these areas include white-tailed deer, cottontail rabbit, ruffed grouse, grey squirrel, and a limited number of bear in the northern part of the area. The common fur-bearing animals are raccoon, muskrat, mink, beaver, otter, and red fox. Mallards, blue-winged teal, and wood ducks are the most common waterfowl.

### Map Unit 3

The soils in this map unit range from nearly level to moderately steep. The soils are loamy and are mainly used for farming. Corn, oats, and alfalfa are the main crops. Native grasses and shrubs in fence rows, small scattered woodlands, and wet depressions provide most of the habitat cover. The major game and fur-bearing animals inhabiting this area include cottontail rabbit, fox squirrel, raccoon, red fox, badger, and white-tailed deer; the common waterfowl are mallards and blue-winged teal. Proper management of the scattered woodlands and wetlands improves the population of the game and fur-bearing animals, waterfowl, and numerous nongame species in this wildlife area.

### Map Units 4 and 5

The soils in these map units are nearly level and gently sloping and are silty and loamy. About half of these lands are farmed. The wetter soils support scattered woodlands and native grasses and provide most of the habitat cover. Wetland types are wooded swamps (type 7) and shrub swamps (type 6) (6). The major game animals include cottontail rabbit, ruffed grouse, white-tailed deer, and a very limited number of pheasants in the southern part of the area. The common fur-bearing animals are raccoon, muskrat, red fox, mink, and otter. Mallards, blue-winged teal, and wood ducks are the most common waterfowl.

### Map Unit 6

This map unit consists of nearly level, organic soils. In about 50 percent of the area, the soils are forested and the remainder of the map unit is in wet meadow. Most of this acreage is not farmed; however, in some of the open areas marsh hay is occasionally cut. Wetlands are the principal wildlife habitat in the area. The wetland soils are subject to flooding and ponding. Wetland types are: fresh meadows (type 2), shallow fresh marshes (type 3), deep fresh marshes (type 4), open fresh water (type 5), and shrub swamps (type 6). The major fur-bearing animals are muskrat, otter, and mink. The wetland areas support a significant breeding population of waterfowl, including mallards, wood ducks, and blue-winged teal.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and

other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, brome grass, clover, and alfalfa.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, switchgrass, goldenrod, beggarweed, tickclover, and ragweed.

*Hardwood trees* and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, aspen, poplar, cherry, maple, basswood, hawthorn, dogwood, blackberry, and blueberry.

*Coniferous plants* furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include Hungarian partridge, pheasant, meadowlark, bobolink, bluebird, field sparrow, cottontail, and red fox.

*Habitat for woodland wildlife* consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, red fox, raccoon, deer, and bear.

*Habitat for wetland wildlife* consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, otter, and beaver.

## Engineering

Robert E. Wilson, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for*

*planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

## Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local

roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost-action potential, and depth to a high water table affect the traffic-supporting capacity.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil

reaction, a high water table, depth to bedrock, and the available water capacity in the upper 40 inches affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

### Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level

floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excessive gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and

are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plant growth. Material from the surface layer, therefore, should be stockpiled for use as the final cover.

### Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10,

a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand and gravel* are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and bedrock.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic

matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

## Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and divisions, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts. A high water table affects the amount of usable material. It also affects trafficability.

*Drainage* is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding;

slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone. Availability of drainage outlets is not considered in the ratings.

*Irrigation* is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone and soil reaction.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of water erosion or soil blowing, an excessively coarse texture, and restricted permeability adversely affect maintenance.

*Grassed waterways* are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

# Soil Properties

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Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is more than 15 to 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

*Classification* of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 18.

*Rock fragments* larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit and plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

## Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of

plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility of soil to soil blowing and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are

thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that

delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Subsidence* is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the expected total subsidence, which usually is a result of drainage and oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

*Potential frost action* is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density,

permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

## Engineering Index Test Data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by the Wisconsin Department of Transportation, Division of Highways, in cooperation with the Federal Highway Administration, U.S. Department of Transportation, in accordance with standard procedures of the American Association of State Highway and Transportation Officials (AASHTO) (1).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

# Classification of the Soils

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The system of soil classification used by the National Cooperative Soil Survey has six categories (11). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

**ORDER.** Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

**SUBORDER.** Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Psamment (*Psam*, meaning sand, plus *ent*, from Entisol).

**GREAT GROUP.** Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Udipsamments (*Udi*, meaning humid, plus *psamment*, the suborder of the Entisols that have a udic moisture regime).

**SUBGROUP.** Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Udipsamments.

**FAMILY.** Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties

and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is mixed, mesic Typic Udipsamments.

**SERIES.** The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

## Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (9). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (11). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

### Angelica Series

The Angelica series consists of poorly drained soils in depressions on moraines. These soils are moderately slowly permeable. They formed in loamy glacial till. The slope ranges from 0 to 2 percent.

Angelica soils commonly are adjacent to Cathro, Markey, and Symco soils. The Cathro and Markey soils formed in 16 to 51 inches of muck. They are very poorly drained and are in slightly lower positions on the landscape than the Angelica soils. The Symco soils are somewhat poorly drained and are in slightly higher positions on the landscape.

Typical pedon of Angelica silt loam, approximately 1,330 feet east and 150 feet south of the northwest corner of sec. 34, T. 24 N., R. 14 E.

- Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak very fine subangular blocky structure; friable; many roots; about 1 percent pebbles; neutral; abrupt smooth boundary.
- Bg1—8 to 11 inches; light brownish gray (10YR 6/2) loam; many medium prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; friable; few roots; about 1 percent pebbles; neutral; clear wavy boundary.
- Bg2—11 to 16 inches; brown (7.5YR 5/2) loam; many medium prominent reddish yellow (7.5YR 6/8) mottles; weak fine subangular blocky structure; friable; few roots; about 1 percent pebbles; neutral; clear wavy boundary.
- BC—16 to 25 inches; reddish brown (5YR 5/4) loam; few fine prominent reddish yellow (7.5YR 6/8) mottles; weak fine subangular blocky structure; friable; few roots; about 10 percent pebbles; neutral; clear wavy boundary.
- C—25 to 60 inches; reddish brown (5YR 5/4) loam; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; friable; about 10 percent pebbles; slight effervescence; mildly alkaline.

The solum is 15 to 30 inches thick. It is neutral to mildly alkaline. The substratum is mildly alkaline or moderately alkaline. Free carbonates are at a depth of 15 to 30 inches. Pebbles or cobbles make up 0 to 15 percent of the solum and substratum.

The Ap horizon has value of 3 or 4 and chroma of 1 or 2. The Bg horizon is dominantly loam, but in some pedons there is a thin subhorizon of sandy loam, clay loam, or sandy clay loam. The Bg horizon has hue of 10YR, 7.5YR, or 5YR and value of 5 to 7. The C horizon is loam or sandy loam. Pebbles or cobbles, or both, make up 5 to 15 percent of the C horizon.

## Borth Series

The Borth series consists of moderately well drained soils on low ridges in glacial lake basins. Permeability of the Borth soils is moderately slow or slow in the solum and rapid in the substratum. These soils formed in clayey water-laid deposits underlain by sand. The slope ranges from 1 to 4 percent.

These soils have a lighter surface layer when dry than that defined as the range for the Borth series. This difference does not affect the use or behavior of the soils.

Borth soils commonly are adjacent to Oshkosh and Tustin soils. Oshkosh and Tustin soils and Borth soils are in similar positions on the landscape. Oshkosh soils have clayey B and C horizons. Tustin soils have 20 to 36

inches of sandy deposits over a loamy and clayey B horizon and a sandy C horizon.

Typical pedon of Borth silty clay loam, 1 to 4 percent slopes (fig. 10), approximately 1,520 feet north and 2,400 feet east of the southwest corner of sec. 31, T. 21 N., R. 14 E.

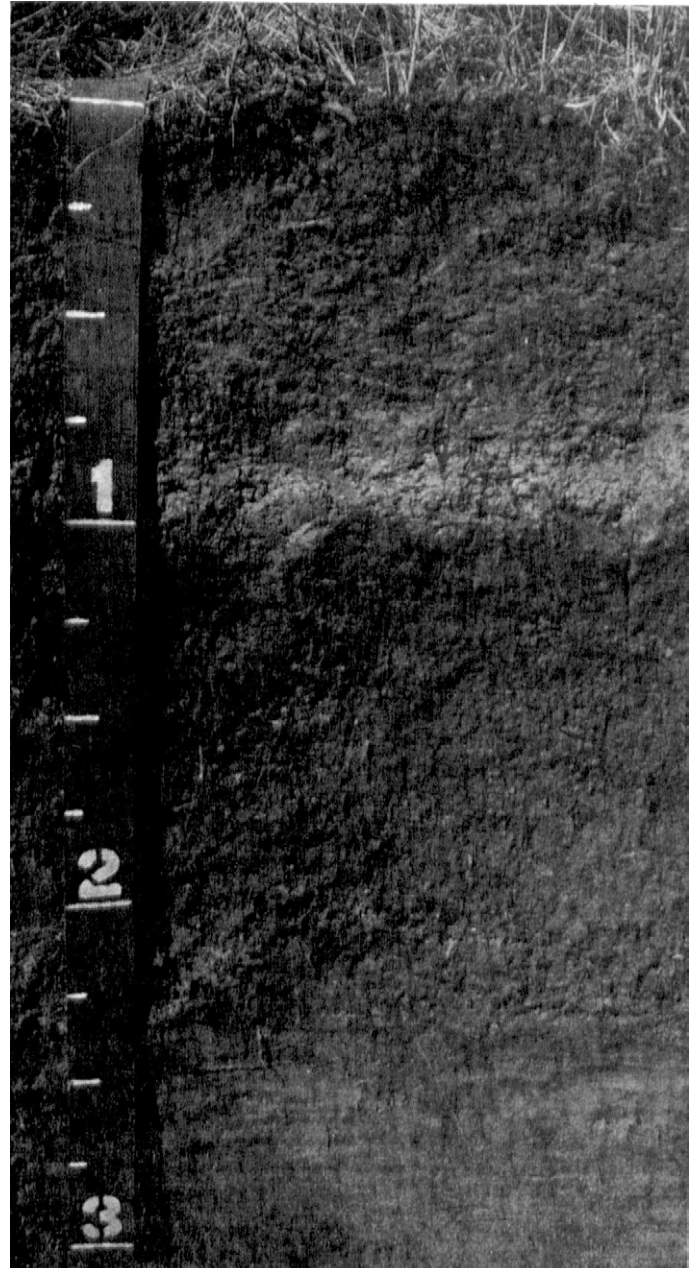


Figure 10.—Profile of Borth silty clay loam, 1 to 4 percent slopes. The light layer is a subsurface layer underlain by a clay subsoil. The scale is in feet.

- Ap—0 to 9 inches; dark brown (7.5YR 3/2) silty clay loam, pinkish gray (7.5YR 6/2) dry; moderate fine granular structure; friable; common roots; slightly acid; abrupt smooth boundary.
- Bt1—9 to 21 inches; reddish brown (5YR 4/4) clay; strong fine angular blocky structure; firm; few roots; many thin continuous clay films on faces of peds; few thin coatings of pale brown (10YR 6/3) on vertical faces of peds in the upper part; many slickensides; slightly acid; clear wavy boundary.
- Bt2—21 to 24 inches; reddish brown (5YR 4/4) clay; common medium distinct reddish gray (5YR 5/2) mottles; strong fine angular blocky structure; firm; few roots; few thin discontinuous clay films on faces of peds; many slickensides; mildly alkaline; abrupt wavy boundary.
- C1—24 to 48 inches; strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) sand; single grained; loose; neutral; abrupt wavy boundary.
- 2C2—48 to 60 inches; dark reddish brown (5YR 3/4) sand; many coarse distinct strong brown (7.5YR 5/6) mottles; single grained; loose; neutral.

The thickness of the solum and the depth to sand range from 20 to 36 inches. Reaction is medium acid to moderately alkaline in the solum. It is neutral or mildly alkaline in the substratum. In some pedons there are free carbonates in the Bt2 horizon.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3. The A or Ap horizon is silty clay loam or sandy loam. In some pedons, there is an E horizon that has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Its texture is similar to that of the Ap horizon. The Bt horizon commonly is clay, but in some pedons, there is a thin subhorizon of silty clay or silty clay loam. The 2C horizon has hue of 10YR through 5YR, value of 3 to 6, and chroma of 2 to 8. It is sand or loamy sand.

## Cathro Series

The Cathro series consists of very poorly drained soils in depressions on moraines, in glacial lake basins, on outwash plains, and on the flood plains. The permeability of the Cathro soil is moderately rapid over moderate or moderately slow. The soils formed in 16 to 51 inches of muck underlain by loamy deposits. The slope ranges from 0 to 2 percent.

Cathro soils are similar to Markey and Seelyeville soils and commonly are adjacent to Angelica, Markey, and Poy soils. Markey and Seelyeville soils are in landscape positions similar to those of the Cathro soils. The Markey soils have a sandy C horizon. The Seelyeville soils formed in muck more than 51 inches thick. The Angelica and Poy soils are poorly drained mineral soils and are in depressions in slightly higher positions on the landscape than the Cathro soils.

Typical pedon of Cathro muck, in an area of Cathro and Markey mucks, approximately 1,400 feet north and 30 feet west of the southeast corner of sec. 33, T. 24 N., R. 14 E.

- Oa1—0 to 24 inches; black (10YR 2/1) broken face, rubbed, and pressed sapric material; about 10 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; many roots; medium acid; clear wavy boundary.
- Oa2—24 to 40 inches; black (N 2/0) broken face, rubbed, and pressed sapric material; about 10 percent fiber, less than 5 percent rubbed; weak very fine subangular blocky structure; medium acid; abrupt wavy boundary.
- Cg—40 to 60 inches; gray (10YR 5/1) loam; massive; friable; about 3 percent pebbles; slightly acid.

The loamy Cg horizon is at a depth of 16 to 51 inches. The organic material is mainly herbaceous; but in some pedons, it is 5 to 10 percent woody fragments. Reaction is medium acid to neutral in the organic layer. It is slightly acid to mildly alkaline in the substratum.

The surface tier has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2 on broken face, rubbed, and pressed.

The subsurface and bottom tiers have hue of 10YR or 7.5YR or are neutral, value is 2 or 3, and chroma ranges from 0 to 2 on broken face, rubbed, and pressed. In some pedons, thin layers of hemic material less than 5 inches thick are in the subsurface tier. In some pedons, organic material is immediately above the Cg horizon and is as much as 50 percent mineral material.

The Cg horizon is dominantly loam; but in some pedons, it is very fine sandy loam, silt loam, or silty clay loam. It has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is 0 to 5 percent pebbles.

## Elderon Series

The Elderon series consists of somewhat excessively drained soils on eskers, kames, and moraines. The permeability of the Elderon soils is rapid over very rapid. These soils formed in sandy and gravelly glacial drift. Slope ranges from 6 to 30 percent.

The Elderon soils commonly are adjacent to Kennan and Rosholt soils. Kennan and Rosholt soils are in positions on the landscape similar to those of the Elderon soils. The Kennan soils contain less sand and gravel throughout the profile than the Elderon soils. The Rosholt soils have more clay in the Bt horizon and contain fewer stones.

Typical pedon of Elderon stony loamy coarse sand, in an area of Elderon-Rosholt complex, 6 to 12 percent slopes, approximately 15 feet north and 2,500 feet west of the southeast corner of sec. 2, T. 25 N., R. 11 E.

- O—2 inches to 0; black (N 2/0) partly decomposed leaves and twigs; about 6 percent of the surface area is covered by stones.
- E—0 to 6 inches; brown (7.5YR 4/4) stony loamy coarse sand, light brown (7.5YR 6/4) dry; weak medium subangular blocky structure; very friable; few fine roots; about 35 percent pebbles; 15 percent cobbles; and 15 percent stones; medium acid; clear wavy boundary.
- Bs—6 to 19 inches; brown (7.5YR 4/4) very gravelly loamy coarse sand, brown (7.5YR 5/4) dry; weak fine subangular blocky structure; very friable; few fine roots; about 40 percent pebbles, 30 percent cobbles, and 15 percent stones; slightly acid; clear wavy boundary.
- Bt1—19 to 33 inches; brown (7.5YR 4/4) very gravelly loamy coarse sand; weak medium subangular blocky structure; very friable; few medium roots; common dark brown (10YR 3/3) coatings on faces of some peds; about 60 percent pebbles, 25 percent cobbles, and 5 percent stones; medium acid; gradual wavy boundary.
- Bt2—33 to 49 inches; brown (7.5YR 4/4) very gravelly loamy coarse sand; weak medium subangular blocky structure; very friable; few thin patchy dark brown (10YR 3/3) clay films; some clay bridging; about 30 percent pebbles, 10 percent cobbles, and 30 percent stones; neutral; clear wavy boundary.
- C—49 to 60 inches; strong brown (7.5YR 5/6) very gravelly coarse sand; single grained; loose; about 30 percent pebbles, 15 percent cobbles, and 30 percent stones; neutral.

The solum is 20 to 50 inches thick. It is neutral to strongly acid. The substratum is neutral or mildly alkaline. Free carbonates are at a depth of more than 60 inches, but in many pedons there are some pebbles of dolomite. Pebbles, cobbles, and stones make up 40 to 90 percent of the solum and substratum. Stones cover 2 to 10 percent of the surface.

The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. In some pedons, the A horizon is 1 to 3 inches thick. It has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. The B horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is typically very gravelly loamy coarse sand, but in some pedons there is a thin subhorizon of very gravelly coarse sandy loam. The C horizon is stratified sand and gravel or a mixture of sand and gravel.

### Fordum Series

The Fordum series consists of poorly drained and very poorly drained soils on the flood plains. The permeability of Fordum soils is moderate over rapid. These soils formed in loamy alluvium underlain by sand. The slope ranges from 0 to 2 percent.

The Fordum soils commonly are adjacent to Cathro, Markey, Minocqua, Roscommon, and Waupaca soils. The Cathro and Markey soils are slightly lower on the landscape than the Fordum soils and formed in 16 to 51 inches of muck. The Minocqua, Roscommon, and Waupaca soils and the Fordum soils are in similar positions on the landscape. Minocqua soils have a more strongly developed solum than that of the Fordum soils. Roscommon soils are sandy throughout. Waupaca soils formed mainly in silty deposits.

Typical pedon of Fordum loam, approximately 500 feet north and 200 feet west of the southeast corner of sec. 11, T. 21 N., R. 13 E.

- A—0 to 9 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; common fine prominent strong brown (7.5YR 5/6) mottles; weak very fine subangular blocky structure; friable; common fine roots; neutral; clear wavy boundary.
- Cg1—9 to 38 inches; dark gray (10YR 4/1) loam with many fine strata of gray (N 5/0) sandy loam and very dark gray (N 3/0) fine sandy loam; common medium prominent strong brown (7.5YR 5/6) mottles; massive; very friable; neutral; abrupt wavy boundary.
- Cg2—38 to 60 inches; gray (10YR 5/1) sand; single grained; loose; neutral.

The sandy Cg2 horizon is at a depth of 25 to 40 inches. Reaction is medium acid to neutral throughout the profile.

The A horizon is 6 to 9 inches thick. It has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. The Cg1 horizon has hue of 10YR or 7.5YR or is neutral; value is 3 to 5, and chroma is 0 to 3. This horizon commonly is stratified loam, sandy loam, and fine sandy loam, but in some pedons there are thin strata of fine sand, sand, or silt loam. The Cg2 horizon is sand, fine sand, loamy sand, or loamy fine sand.

### Hortonville Series

The Hortonville series consists of well drained soils on drumlins and moraines. These soils are moderately permeable. They formed in loamy deposits and calcareous loamy till. The slope ranges from 2 to 20 percent.

The Hortonville soils are similar to the Tilleda soils and commonly are adjacent to Kennan, Rosholt, and Symco soils. Kennan and Tilleda soils are in positions on the landscape similar to those of the Hortonville soils. The Kennan soils have less clay in the Bt and C horizons than the Hortonville soils. The Tilleda soils have free carbonates at a greater depth than the Hortonville soils. Rosholt soils have a sand and gravel 2C horizon. These soils are on outwash plains and stream terraces. Symco

soils are somewhat poorly drained and are in lower positions on the landscape than the Hortonville soils.

Typical pedon of Hortonville fine sandy loam, 2 to 6 percent slopes, approximately 2,580 feet south and 1,080 feet west of the northeast corner of sec. 18, T. 21 N., R. 13 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; common fine roots; about 6 percent pebbles; slightly acid; abrupt smooth boundary.

B/E—9 to 12 inches; dark brown (7.5YR 4/4) sandy clay loam (Bt); strong fine and medium subangular blocky structure; firm; few faint clay films on faces of peds (Bt); about 25 percent brown (10YR 5/3) fine sandy loam, light gray (10YR 7/2) dry, interfingers (E) 2 to 5 millimeters wide; weak medium platy structure; friable; common fine roots; about 1 percent pebbles; few worm holes and casts in upper 1 to 2 inches; slightly acid; clear wavy boundary.

Bt1—12 to 16 inches; reddish brown (5YR 4/4) clay loam; weak coarse prismatic structure parting to strong fine angular blocky; firm; common roots; many faint reddish brown (5YR 4/3) clay films on faces of peds; light gray (10YR 7/2) dry coatings on some vertical faces of peds; about 1 percent pebbles; neutral; clear wavy boundary.

Bt2—16 to 22 inches; reddish brown (5YR 4/4) clay loam; weak coarse prismatic structure parting to strong fine angular blocky; firm; common fine roots; many faint reddish brown (5YR 4/3) clay films on faces of peds; about 5 percent pebbles; mildly alkaline; clear wavy boundary.

Bt—22 to 28 inches; reddish brown (5YR 4/4) loam; moderate medium subangular blocky structure; firm; common fine roots; few faint dark reddish brown (5YR 3/4) clay films on vertical faces of peds; about 12 percent pebbles and 2 percent cobbles; mildly alkaline; clear wavy boundary.

C—28 to 60 inches; reddish brown (5YR 4/4) fine sandy loam; massive; firm; few fine roots; about 10 percent pebbles and 2 percent cobbles; slight effervescence; moderately alkaline.

The solum is 24 to 40 inches thick. It is mildly alkaline to medium acid. The substratum is mildly alkaline or moderately alkaline. Free carbonates are at a depth of 24 to 40 inches. Pebbles and cobbles make up 2 to 15 percent of the solum and substratum.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 3. It is loam or fine sandy loam. In most pedons, the E horizon is mixed with the Ap horizon. In some pedons, there is a separate E horizon, and it has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. The E/B or B/E horizon is 2 to 8 inches thick and has color and texture similar to those of the E and Bt horizons. The Bt1 and Bt2 horizons are clay loam or

silty clay loam, but in some pedons there is a thin or transitional subhorizon of loam. The Bt3 horizon has color similar to that of the Bt1 and Bt2 horizons, but it has a weaker structure. It is clay loam, loam, or fine sandy loam. The C horizon is fine sandy loam, loam, or clay loam.

## Kennan Series

The Kennan series consists of well drained soils on drumlins and moraines. These soils are moderately permeable. They formed in loamy glacial till. The slope ranges from 2 to 30 percent.

The Kennan soils commonly are adjacent to Hortonville, Kranski, Rosholt, and Symco soils. Hortonville and Kranski soils are in positions on the landscape similar to those of the Kennan soils. Hortonville soils have more clay in the B and C horizons than the Kennan soil. Kranski soils have more sand and less clay throughout the profile. Rosholt soils are on outwash plains and stream terraces and have a sand and gravel 2C horizon. Symco soils are somewhat poorly drained. They are in depressions and have more clay in the B and C horizons than the Kennan soil.

Typical pedon of Kennan bouldery sandy loam, 2 to 6 percent slopes, approximately 50 feet south and 1,300 feet east of the northwest corner of sec. 16, T. 25 N., R. 12 E.

A—0 to 2 inches; very dark gray (10YR 3/1) bouldery sandy loam, gray (10YR 5/1) dry; weak fine granular structure; friable; many roots; about 12 percent of the surface is covered by boulders and stones and about 3 percent by pebbles; strongly acid; abrupt wavy boundary.

E—2 to 12 inches; brown (10YR 4/3) sandy loam, very pale brown (10YR 7/3) dry; weak medium platy structure parting to weak fine granular; friable; common roots; about 3 percent pebbles and 35 percent boulders; strongly acid; gradual wavy boundary.

E/B—12 to 21 inches; brown (10YR 4/3) sandy loam, very pale brown (10YR 7/3) dry (E); weak fine subangular blocky structure; friable; about 70 percent tongues extending into and surrounding brown (7.5YR 4/4) sandy loam (Bt); few roots; very thin discontinuous clay films on faces of peds (Bt); about 3 percent pebbles and 25 percent boulders; strongly acid; gradual wavy boundary.

B/E—21 to 31 inches; brown (7.5YR 4/4) sandy loam (Bt); weak fine subangular blocky structure; friable; few roots; few thin discontinuous clay films on faces of peds (Bt); about 40 percent tongues of brown (10YR 4/3) sandy loam (E), very pale brown (10YR 7/3) dry, more than 20 millimeters wide, extending throughout the horizon; about 3 percent pebbles; strongly acid; gradual wavy boundary.

- Bt1—31 to 36 inches; brown (7.5YR 4/4) sandy loam; moderate fine subangular blocky structure; friable; few roots; many moderately thick continuous clay films on faces of peds; thin coatings of E material on vertical faces of peds; about 5 percent pebbles; strongly acid; clear wavy boundary.
- Bt2—36 to 38 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; few roots; few thin discontinuous clay films on faces of peds; about 10 percent pebbles; strongly acid; clear wavy boundary.
- Bt3—38 to 60 inches; brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; few clay films on horizontal faces of peds; about 10 percent pebbles; strongly acid.

The solum is 58 to 70 inches thick. It is strongly acid to neutral. Pebbles make up 2 to 20 percent of the solum. Boulders and stones cover about 25 percent of the surface. They make up 25 to 50 percent of the A horizon.

The A horizon is 1 inch to 4 inches thick. The A or Ap horizon has value of 3 or 4 and chroma of 1 to 3. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. The E/B and B/E horizons have color and texture similar to those of the E and Bt horizons. The Bt1 horizon has hue of 7.5YR or 5YR. It is loam or sandy loam. The Bt2 and Bt3 horizons have hue of 7.5YR or 5YR and value and chroma of 4 or 5. They are sandy loam or loamy sand. In some pedons there is a C horizon above a depth of 60 inches that has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 5. It is sandy loam or loamy sand.

## Kranski Series

The Kranski series consists of somewhat excessively drained soils on moraines. These soils are moderately rapidly permeable. They formed in loamy sand till. The slope ranges from 2 to 20 percent.

These soils have slightly coarser texture in the subsoil than that defined as the range for the Kranski series. This difference does not effect the use or behavior of these soils.

The Kranski soils commonly are adjacent to Kennan, Plainfield, and Richford soils. Kennan soils have more clay in the A and B horizons than Kranski soils, but their positions on the landscape are similar to those of the Kranski soils. Plainfield soils have a sand B horizon and C horizon. They are on outwash plains and stream terraces. Richford soils have a sandy loam Bt horizon. They are on outwash plains and terraces.

Typical pedon of Kranski loamy sand, 6 to 12 percent slopes, approximately 20 feet south and 1,900 feet west of northeast corner of sec. 33, T. 21 N., R. 11 E.

- Ap—0 to 8 inches; dark brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak medium granular

structure; very friable; common roots; medium acid; abrupt smooth boundary.

- BA—8 to 17 inches; dark brown (7.5YR 4/4) loamy sand; weak thick platy structure parting to weak medium subangular blocky; very friable; few roots; about 5 percent pebbles; strongly acid; clear wavy boundary.
- Bt1—17 to 22 inches; dark brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; few roots; clay bridging of sand grains; about 9 percent pebbles; strongly acid; clear wavy boundary.
- Bt2—22 to 26 inches; reddish brown (5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; few roots; clay bridging of sand grains; about 10 percent pebbles; strongly acid; clear wavy boundary.
- Bt3—26 to 34 inches; reddish brown (5YR 4/4) loamy sand; weak coarse subangular blocky structure; very friable; few roots; clay bridging of sand grains; about 10 percent pebbles; strongly acid; clear wavy boundary.
- C—34 to 60 inches; dark brown (7.5YR 4/4) loamy sand; massive; very friable; about 12 percent pebbles; medium acid.

The solum is 24 to 45 inches thick. It is slightly acid to strongly acid. The substratum is mildly alkaline to medium acid. In some pedons there are free carbonates between depths of 40 and 60 inches. Pebbles and cobbles make up 5 to 15 percent of the subsoil and 5 to 20 percent of the C horizon.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. In some pedons, there is a loamy sand E horizon that has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. The BA horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. In some pedons, there is a horizon that has colors similar to those of a spodic horizon, but it lacks the organic matter, iron, and aluminum of a spodic horizon. The Bt horizon has hue of 7.5YR or 5YR. The C horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is loamy sand or gravelly loamy sand.

## Loxley Series

The Loxley series consists of very poorly drained soils in depressions on moraines. These soils are moderately rapidly permeable. They formed in more than 51 inches of organic material. The slope ranges from 0 to 2 percent.

Loxley soils are similar to Cathro, Markey, and Seelyeville soils and commonly are adjacent to them. These soils are all in similar positions on the landscape. The Cathro and Markey soils formed in muck less than 51 inches thick. The Seelyeville soils formed in muck

more than 51 inches thick, but they are less acid than the Loxley soils.

Typical pedon of Loxley mucky peat, approximately 1,280 feet north and 1,300 feet east of the southwest corner of sec. 6, T. 25 N., R. 11 E.

- Oi—0 to 2 inches; dark brown (7.5YR 4/4) broken face, dark yellowish brown (10YR 4/4) rubbed, and dark brown (7.5YR 3/2) pressed fibric material from sphagnum moss; about 80 percent fiber, 50 percent rubbed; weak thick platy structure; many roots; extremely acid; clear wavy boundary.
- Oa1—2 to 6 inches; black (10YR 2/1) broken face, rubbed, and pressed sapric material from sphagnum moss; about 60 percent fiber, 9 percent rubbed; weak thick platy structure; many roots; extremely acid; clear wavy boundary.
- Oa2—6 to 14 inches; very dark brown (10YR 2/2) broken face, rubbed, and pressed sapric material from sedges; about 10 percent fiber, less than 2 percent rubbed; weak thick platy structure; few roots; extremely acid; clear wavy boundary.
- Oa3—14 to 36 inches; very dark brown (10YR 2/2) broken face, rubbed, and pressed sapric material; about 20 percent fiber, 3 percent rubbed; weak medium platy structure; extremely acid; clear wavy boundary.
- Oa4—36 to 42 inches; very dark brown (10YR 2/2) broken face, rubbed, and pressed sapric material; about 40 percent fiber, 9 percent rubbed; weak medium platy structure; extremely acid; clear wavy boundary.
- Oa5—42 to 54 inches; dark brown (7.5YR 3/2) broken face and very dark brown (10YR 2/2) rubbed and pressed sapric material; about 60 percent fiber, 4 percent rubbed; massive; extremely acid; clear wavy boundary.
- Oa6—54 to 60 inches; very dark brown (10YR 2/2) broken face, rubbed, and pressed sapric material; about 20 percent fiber, 4 percent rubbed; massive; extremely acid.

The organic material is more than 51 inches thick.

The Oi horizon is 1 to 4 inches thick. It is fibric material that formed in sphagnum moss. The Oa1 horizon is 3 to 9 inches thick. It is sapric or hemic material that formed in sphagnum moss. The subsurface tier is sapric material that formed in sedges. The sapric material layers within the subsurface tier have hue of 5YR, 7.5YR, or 10YR and value and chroma of 2 or 3.

## Markey Series

The Markey series consists of very poorly drained soils in depressions on moraines, in glacial lake basins, on outwash plains, and on the flood plains. These soils are moderately rapidly permeable. They formed in 16 to 51

inches of muck underlain by sand. The slope ranges from 0 to 2 percent.

Markey soils are similar to Cathro and Seelyeville soils and commonly are adjacent to Cathro and Roscommon soils. Cathro and Seelyeville soils are in positions on the landscape similar to those of the Markey soils. Cathro soils are underlain by loamy deposits at a depth of 16 to 51 inches. Roscommon soils are slightly higher on the landscape than the Markey soils. They are in depressions and are sandy throughout. Seelyeville soils formed in muck more than 51 inches thick.

Typical pedon of Markey muck, in an area of Cathro and Markey mucks, approximately 200 feet east and 450 feet south of the northwest corner of sec. 27, T. 24 N., R. 14 E.

- Oa1—0 to 12 inches; black (10YR 2/1) broken face, very dark brown (10YR 2/2) rubbed, and very dark grayish brown (10YR 3/2) pressed sapric material; about 10 percent fiber, less than 5 percent rubbed; weak fine granular structure; many roots; slightly acid; clear wavy boundary.
- Oa2—12 to 21 inches; black (10YR 2/1) broken face, rubbed, and pressed sapric material; about 8 percent fiber, less than 5 percent rubbed; weak thin platy structure; common roots; slightly acid; abrupt wavy boundary.
- C—21 to 60 inches; brown (10YR 5/3) sand; single grained; loose; mildly alkaline.

The sandy C horizon is at a depth of 16 to 51 inches. The organic material is mainly herbaceous, but in some pedons, it is 10 percent woody fragments. Reaction is slightly acid to mildly alkaline in the organic layer and in the substratum.

The surface tier has hue of 10YR or is neutral; value is 2 or 3, and chroma is 0 to 2 on broken face and rubbed. The subsurface and bottom tiers have hue of 10YR, 7.5YR, or 5YR or are neutral; value is 2 or 3 and chroma is 0 to 2. In some pedons, there are thin layers of hemic material less than 5 inches thick in the subsurface and bottom tiers. In some pedons, there is a thin sapric layer immediately above the C horizon that is as much as 20 percent, by volume, mineral material. The C horizon is dominantly sand or loamy sand, but in some pedons, it is as much as 8 percent gravel.

## Meehan Series

The Meehan series consists of somewhat poorly drained soils in drainageways and shallow swales, on outwash plains, and on stream terraces. These soils are rapidly permeable. They formed in sandy deposits. The slope ranges from 0 to 3 percent.

Meehan soils commonly are adjacent to Plainfield, Oesterle, Nebago, and Roscommon soils. The Plainfield soils are moderately well drained and excessively

drained. They are higher on the landscape than the Meehan soils. The Oesterle soils are in positions on the landscape similar to those of the Meehan soils but have a sandy loam A and Bt horizon. The Nebago soils have clayey 2B and 2C horizons. They are in glacial lake basins. The Roscommon soils are poorly drained and are slightly lower on the landscape than the Meehan soils.

Typical pedon of Meehan loamy sand, approximately 2,620 feet south and 1,670 feet west of the northeast corner of sec. 16, T. 23 N., R. 12 E.

- Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak medium granular structure; very friable; many roots; strongly acid; abrupt smooth boundary.
- Bw1—9 to 16 inches; brown (7.5YR 5/4) loamy sand; many coarse prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; very friable; few roots; about 3 percent pebbles; strongly acid; clear wavy boundary.
- Bw2—16 to 20 inches; brown (7.5YR 5/4) sand; many coarse distinct reddish gray (5YR 5/2) and many coarse prominent yellowish red (5YR 5/8) mottles; weak coarse subangular blocky structure; very friable; about 4 percent pebbles; strongly acid; clear wavy boundary.
- Bw3—20 to 26 inches; yellowish brown (10YR 5/4) sand; many coarse distinct reddish gray (10YR 5/2) and common coarse distinct yellowish red (5YR 5/6) mottles; weak coarse subangular blocky structure; very friable; medium acid; clear wavy boundary.
- C—26 to 60 inches; light brown (7.5YR 6/4) sand; many coarse distinct pinkish gray (7.5YR 7/2) mottles; single grained; loose; slightly acid.

The solum is 24 to 39 inches thick. It is neutral to strongly acid. The substratum above a depth of 40 inches is medium acid to neutral. Pebbles make up 0 to 15 percent of the subsoil and substratum.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bw1 horizon is loamy sand or sand. It has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. The Bw2 and Bw3 horizons have hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 8. In some pedons, the lower part of the Bw3 horizon is single grained. The C horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 4. In some pedons, the substratum below a depth of 40 inches is loam and contains free carbonates.

## Menasha Series

The Menasha series consists of poorly drained soils in depressions on stream terraces and in glacial lake basins. These soils are slowly or very slowly permeable. They formed in clayey water-laid deposits. The slope ranges from 0 to 2 percent.

Menasha soils commonly are adjacent on the landscape to Cathro, Markey, and Neenah soils. Cathro and Markey soils formed in 16 to 51 inches of muck. They are very poorly drained and are slightly lower on the landscape than the Menasha soils. Neenah soils are somewhat poorly drained and are slightly higher on the landscape than the Menasha soils.

Typical pedon of Menasha silty clay, approximately 1,120 feet north and 50 feet east of the southwest corner of sec. 17, T. 22 N., R. 14 E.

- Ap—0 to 12 inches; black (N 2/0) silty clay, very dark gray (N/ 3/0) dry; moderate medium granular structure; firm; common roots; neutral; abrupt smooth boundary.
- Bg—12 to 20 inches; gray (5Y 5/1) clay; common medium prominent yellowish brown (10YR 5/8) mottles; strong fine angular blocky structure; firm; few roots; neutral; clear wavy boundary.
- BC—20 to 29 inches; gray (5Y 5/1) and reddish brown (5YR 5/3) clay; strong medium subangular blocky structure; firm; neutral; gradual wavy boundary.
- C—29 to 60 inches; reddish brown (5YR 5/3) clay; many coarse prominent gray (5Y 5/1) mottles; massive; firm; many light gray (10YR 7/1) soft carbonate accumulations; violent effervescence; mildly alkaline.

The solum is 24 to 30 inches thick. It is neutral or mildly alkaline. The substratum is mildly alkaline or moderately alkaline. Typically, free carbonates are at a depth of 24 to 30 inches, but in some pedons there are free carbonates in the BC horizon.

The Ap horizon has hue of 10YR or is neutral; value is 2 or 3, and chroma is 0 or 1. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. Typically, it is clay, but in some pedons there is a thin or transitional horizon of silty clay. The BC horizon has color similar to that of the Bg or C horizon. The C horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 3 or 4. Typically, it is clay, but in some pedons there are very thin strata of silty clay, silt, or very fine sand.

## Military Series

The Military series consists of moderately deep, well drained soils on glaciated uplands. These soils are moderately permeable. They formed in sandy and loamy deposits underlain by sandstone bedrock. The slope ranges from 3 to 8 percent.

These soils have a dark surface layer that is slightly thicker than that defined as the range for the Military series. This difference does not affect the use or behavior of the soils.

The Military soils commonly are adjacent to Hortonville, Shawano, Symco, and Whalan soils. Unlike the Military soils, the Hortonville, Shawano, and Symco

soils do not have bedrock within a depth of 60 inches. The Hortonville soils are loamy throughout. They are on drumlins and moraines. The Shawano soils are sandy throughout. They are on old lake beaches. The Symco soils are somewhat poorly drained and are loamy throughout. They are lower on the landscape than the Military soils. The Whalan soils are in positions on the landscape similar to those of the Military soils and are underlain by dolomite.

Typical pedon of Military loamy sand, 3 to 8 percent slopes, approximately 1,002 feet north and 605 feet east of the southwest corner of sec. 22, T. 21 N., R. 14 E.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy sand, brown (10YR 5/3) dry; weak very fine subangular blocky structure; very friable; common roots; medium acid; abrupt smooth boundary.

BE—10 to 17 inches; yellowish red (5YR 4/6) sandy loam; weak medium subangular blocky structure; very friable; few roots; about 5 percent pebbles; slightly acid; clear wavy boundary.

Bt1—17 to 25 inches; reddish brown (5YR 4/4) sandy clay loam; moderate fine subangular blocky structure; firm; few roots; thin continuous clay films on faces of peds; about 5 percent pebbles; slightly acid; clear wavy boundary.

Bt2—25 to 27 inches; yellowish red (5YR 4/6) loam; moderate medium subangular blocky structure; firm; few roots; few thin patchy clay films on faces of peds; about 5 percent pebbles; strongly acid; abrupt wavy boundary.

Cr—27 to 33 inches; yellowish brown (10YR 5/4) slightly weathered sandstone.

2R—33 inches; yellowish brown (10YR 5/4) sandstone.

The solum is 20 to 40 inches thick. It is neutral to strongly acid. Sandstone is at a depth of 20 to 40 inches. Pebbles make up 0 to 10 percent of the solum.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The BE horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy loam or loam. The Bt1 horizon is clay loam or sandy clay loam. The Bt2 horizon is loam or sandy clay loam. In some pedons, it does not have translocated clay. The 2Cr horizon is 0 to 12 inches thick.

## Minocqua Series

The Minocqua series consists of poorly drained soils in drainageways and depressions on outwash plains. The permeability of Minocqua soils is moderate over rapid or very rapid. These soils formed in dominantly loamy deposits underlain by sand. The slope ranges from 0 to 2 percent.

These soils have more fine sand or coarse material in the Bg horizon than that defined in the range for the Minocqua series. This difference does not affect the use or behavior of the soils.

The Minocqua soils commonly are adjacent on the landscape to Angelica, Oesterle, and Roscommon soils. The Angelica soils have more silt and clay in the solum than the Minocqua soils and have a loam C horizon. They are in depressions on till plains. The Oesterle soils are somewhat poorly drained. They are higher on the landscape than the Minocqua soils. Roscommon soils and Minocqua soils are in similar positions on the landscape. Roscommon soils are sandy throughout.

Typical pedon of Minocqua mucky fine sandy loam, approximately 1,290 feet north and 1,020 feet east of the southwest corner of sec. 19, T. 25 N., R. 11 E.

A—0 to 7 inches; black (N 2/0) mucky fine sandy loam, dark gray (N 4/0) dry; weak fine granular structure; friable; many roots; strongly acid; clear wavy boundary.

Bg1—7 to 19 inches; grayish brown (10YR 5/2) sandy loam, light gray (10YR 7/2) dry; common medium prominent yellowish red (5YR 5/8) mottles; weak very thick platy structure parting to weak medium subangular blocky; very friable; strongly acid; clear wavy boundary.

Bg2—19 to 37 inches; grayish brown (10YR 5/2) sandy loam; many medium prominent yellowish red (5YR 5/8) mottles; weak very thick platy structure parting to weak medium subangular blocky; friable; medium acid; abrupt wavy boundary.

2C—37 to 60 inches; brown (10YR 5/3) sand; many coarse prominent yellowish brown (10YR 5/8) mottles; single grained; loose; slightly acid.

The solum is 24 to 40 inches thick. It is medium acid or strongly acid. The substratum is medium acid to neutral. In most pedons there are no coarse fragments, but in some pedons, pebbles make up 5 to 10 percent of the subsoil and substratum.

The A horizon is 5 to 7 inches thick. It is neutral or has hue of 10YR, value of 2 or 3, and chroma of 0 to 2. The Bg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy loam or loam.

## Nebago Series

The Nebago series consists of somewhat poorly drained soils in glacial lake basins. The permeability of Nebago soils is rapid over moderately slow or slow over rapid. These soils formed in sandy deposits and in the underlying clayey deposits. The slope ranges from 0 to 2 percent.

The Nebago soils commonly are adjacent to Borth, Meehan, and Tustin soils. The Borth and Tustin soils are higher on the landscape than the Nebago soils. Borth soils are moderately well drained. They formed in clay deposits underlain by sand. Tustin soils are well drained. Meehan soils are sandy throughout. They are in

drainageways and shallow swales on outwash plains and stream terraces.

Typical pedon of Nebago loamy sand, sandy substratum, approximately 2,080 feet north and 2,635 feet east of the southwest corner of sec. 32, T. 21 N., R. 14 E.

- Ap—0 to 9 inches; very dark gray (10YR 3/1) loamy sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; common roots; medium acid; abrupt smooth boundary.
- E—9 to 13 inches; light brownish gray (10YR 6/2) loamy sand, white (10YR 8/1) dry; weak very fine subangular blocky structure; very friable; common roots; medium acid; abrupt wavy boundary.
- Bw1—13 to 18 inches; dark brown (10YR 4/3) sand; single grained; loose; common roots; medium acid; clear wavy boundary.
- Bw2—18 to 31 inches; dark yellowish brown (10YR 4/4) sand; common medium prominent strong brown (7.5YR 5/8) and few medium distinct pinkish gray (7.5YR 6/2) mottles; single grained; loose; few roots; medium acid; abrupt wavy boundary.
- 2Bw3—31 to 48 inches; reddish brown (5YR 4/4) silty clay; many coarse prominent light gray (5YR 6/1) mottles; moderate very fine subangular blocky structure; firm; slightly acid; clear wavy boundary.
- 2C1—48 to 54 inches; reddish brown (5YR 4/4) silty clay; many coarse prominent light gray (5YR 6/1) mottles; massive; firm; neutral; abrupt wavy boundary.
- 3C2—54 to 60 inches; pale brown (10YR 6/3) sand; common medium prominent brownish yellow (10YR 6/8) mottles; single grained; loose; neutral.

The solum is 36 to 48 inches thick. It is neutral to medium acid. The substratum is neutral to moderately alkaline. In some pedons there are free carbonates at a depth of more than 40 inches. The sandy upper story is 20 to 36 inches thick.

The Ap horizon has value of 2 to 4 and chroma of 1 or 3. The Bw1 and Bw2 horizons have value of 4 to 6 and chroma of 3 or 4. They are sand or loamy sand. The 2Bw horizon is silty clay or clay, but in some pedons there is a thin subhorizon of silty clay loam. The 2C1 horizon typically is silty clay or clay, but in some pedons, it has thin layers of silty clay loam. The 2Bw and 2C1 horizons are more than 12 inches thick. The 3C2 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4.

## Neenah Series

The Neenah series consists of somewhat poorly drained soils in drainageways in glacial lake basins. These soils are slowly or very slowly permeable. They formed in clayey water-laid deposits. The slope ranges from 0 to 3 percent.

These soils have a slightly thinner solum than that defined as the range for the Neenah series. This difference, however, does not affect the use or behavior of the soils.

The Neenah soils commonly are adjacent to Menasha, Nebago, and Oshkosh soils. Menasha soils are lower on the landscape than the Neenah soils; they are poorly drained. Nebago soils and the Neenah soils are in similar positions. Nebago soils have 20 to 36 inches of sandy deposits over clayey deposits. Oshkosh soils are higher on the landscape than the Neenah soils; they are well drained.

Typical pedon of Neenah silty clay, 0 to 3 percent slopes, approximately 1,980 feet north and 2,040 feet west of the southeast corner of sec. 17, T. 22 N., R. 14 E.

- Ap—0 to 8 inches; black (10YR 2/1) silty clay, gray (10YR 5/1) dry; moderate medium granular structure; firm; common roots; neutral; abrupt smooth boundary.
- Bt1—8 to 14 inches; brown (7.5YR 5/4) clay; common medium distinct yellowish red (5YR 5/6) and few medium distinct reddish gray (5YR 5/2) mottles; strong very fine angular blocky structure; firm; few roots; common thin continuous clay films on faces of peds; neutral; clear wavy boundary.
- Bt2—14 to 16 inches; reddish brown (5YR 4/4) clay; many coarse prominent light greenish gray (5GY 7/1) mottles; strong very fine angular blocky structure; firm; many thin continuous clay films on faces of peds; neutral; clear wavy boundary.
- C—16 to 60 inches; reddish brown (5YR 4/4) clay; many coarse distinct pinkish gray (5YR 6/2) mottles; weak coarse angular blocky structure; firm; many greenish gray (5GY 6/1) soft carbonate accumulations; violent effervescence; mildly alkaline.

The solum is 15 to 20 inches thick. It is neutral or mildly alkaline. The substratum is mildly alkaline or moderately alkaline.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon is clay, but in some pedons there is a thin subhorizon of silty clay. The C horizon is clay, but in some pedons it has very thin strata of silty clay, silt, or very fine sand.

## Oesterle Series

The Oesterle series consists of somewhat poorly drained soils in drainageways on outwash plains and stream terraces. The permeability of Oesterle soils is moderate over very rapid. These soils formed in loamy and sandy deposits underlain by sand and gravel. The slope ranges from 0 to 3 percent.

Oesterle soils commonly are adjacent on the landscape to Minocqua and Rosholt soils. Minocqua

soils are poorly drained and are lower on the landscape than the Oesterle soils. Rosholt soils are well drained and are higher on the landscape.

Typical pedon of Oesterle sandy loam, 0 to 3 percent slopes, approximately 1,980 feet north and 1,200 feet west of the southeast corner of sec. 27, T. 25 N., R. 12 E.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; many fine roots; about 5 percent pebbles; medium acid; abrupt smooth boundary.
- E/B—8 to 12 inches; brown (10YR 5/3) sandy loam, very pale brown (10YR 7/3) dry (E); few medium prominent yellowish brown (10YR 5/8) mottles; weak very fine subangular blocky structure; very friable; about 60 percent tongues extending into and surrounding brown (7.5YR 4/4) sandy loam (Bt); weak medium subangular blocky structure; friable; few roots; thin patchy clay films on faces of peds (Bt); about 5 percent pebbles; strongly acid; clear wavy boundary.
- Bt—12 to 24 inches; brown (7.5YR 4/4) sandy loam; common medium prominent yellowish brown (10YR 5/8) and common medium distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; few roots; few thin continuous clay films on faces of peds; about 5 percent pebbles; strongly acid; clear wavy boundary.
- BC—24 to 28 inches; brown (7.5YR 4/4) loamy sand; many coarse prominent yellowish brown (10YR 5/8) and many medium distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; very friable; about 5 percent pebbles; strongly acid; abrupt wavy boundary.
- 2C1—28 to 40 inches; strong brown (7.5YR 5/6) sand; many coarse distinct strong brown (7.5YR 5/8) mottles; single grained; loose; about 10 percent pebbles; medium acid; abrupt wavy boundary.
- 2C2—40 to 60 inches; strong brown (7.5YR 5/8) and light brownish gray (10YR 6/2) gravelly sand; single grained; loose; about 15 percent pebbles; medium acid.

The solum is 24 to 36 inches thick. Reaction is slightly acid to strongly acid in the solum and substratum. Pebbles make up 5 to 10 percent of the solum and 10 to 25 percent of the substratum. In some pedons, cobbles make up 1 to 5 percent of the solum and substratum.

The Ap horizon has a value of 2 or 3 and chroma of 1 to 3. In some pedons there is an E horizon that has value of 5 or 6 and chroma of 2 or 3. It is 3 to 5 inches thick. The Bt horizon has hue of 7.5YR or 10YR. It is sandy loam or loam. The BC horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 2 to 8. It is loamy sand, gravelly loamy sand, or sandy loam. The 2C

horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 8. It is gravelly sand or sand.

## Oshkosh Series

The Oshkosh series consists of well drained soils in glacial lake basins. These soils are slowly or very slowly permeable. They formed mainly in clayey water-laid deposits. The slope ranges from 2 to 6 percent.

Oshkosh soils commonly are adjacent to Borth, Neenah, and Tustin soils. Borth and Tustin soils and the Oshkosh soils are in similar positions on the landscape. Borth soils have sand within 20 to 36 inches of the surface. Neenah soils are somewhat poorly drained; they are lower on the landscape than the Oshkosh soils. Tustin soils have 20 to 36 inches of sandy deposits over a loamy and clayey B horizon and a sandy C horizon.

Typical pedon of Oshkosh silty clay loam, 2 to 6 percent slopes, approximately 20 feet north and 2,310 feet west of the southeast corner of sec. 17, T. 22 N., R. 14 E.

- Ap—0 to 10 inches; dark brown (7.5YR 4/2) silty clay loam, pinkish gray (7.5YR 6/2) dry; moderate very fine subangular blocky structure; firm; many roots; slightly acid; abrupt smooth boundary.
- Bt1—10 to 16 inches; reddish brown (5YR 4/4) clay; moderate fine subangular blocky structure; firm; few roots; common thin continuous clay films on faces of peds; many slickensides; medium acid; clear wavy boundary.
- Bt2—16 to 24 inches; reddish brown (5YR 4/4) clay; strong fine angular blocky structure; firm; few roots; thin continuous clay films on faces of peds; many slickensides; slightly acid; clear wavy boundary.
- BC—24 to 28 inches; reddish brown (5YR 4/4) clay; moderate fine subangular blocky structure; firm; few roots; violent effervescence; mildly alkaline; clear wavy boundary.
- C—28 to 60 inches; reddish brown (5YR 5/4) clay; weak medium platy structure becoming massive with increasing depth; firm; many light gray (10YR 7/2) soft carbonate accumulations; violent effervescence; mildly alkaline.

The solum is 24 to 36 inches thick. It is medium acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline.

The Ap horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. In some pedons there is an E horizon that has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 1 or 2. The Bt horizon commonly is clay, but in some pedons there is a thin subhorizon of silty clay. The BC horizon has value and chroma of 3 to 5. It is silty clay or clay. The C horizon typically is clay, but in some pedons there are very thin strata of silty clay, silt, or very fine sand.

## Plainfield Series

The Plainfield series consists of excessively drained and moderately well drained soils on outwash plains, stream terraces, and moraines. These soils are rapidly permeable. They formed in sand. The slope ranges from 0 to 30 percent.

The Plainfield soils are similar to the Shawano soils and are commonly adjacent to the Meehan and Tustin soils. The Plainfield soils and the Shawano soils are in similar positions on the landscape. The Shawano soils formed in fine sand. The Meehan soils are somewhat poorly drained and are lower on the landscape than the Plainfield soils. The Tustin soils are in glacial lake basins. They have clayey deposits within a depth of 36 inches.

Typical pedon of Plainfield loamy sand, 2 to 6 percent slopes, approximately 1,950 feet south and 1,000 feet east of the northwest corner of sec. 19, T. 22 N., R. 14 E.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; common roots; slightly acid; abrupt smooth boundary.
- Bw—8 to 16 inches; brown (7.5YR 4/4) sand; weak medium subangular blocky structure; very friable; few roots; slightly acid; clear wavy boundary.
- BC—16 to 25 inches; strong brown (7.5YR 5/6) sand; single grained; loose; few roots; slightly acid; clear wavy boundary.
- C1—25 to 35 inches; yellowish brown (10YR 5/6) sand; single grained; loose; slightly acid; gradual wavy boundary.
- C2—35 to 47 inches; brownish yellow (10YR 6/6) sand; single grained; loose; slightly acid; gradual wavy boundary.
- C3—47 to 60 inches; yellowish brown (10YR 5/8) sand; single grained; loose; slightly acid.

The solum ranges from 18 to 34 inches in thickness. Reaction is slightly acid or medium acid in the solum. It ranges from slightly acid to strongly acid in the substratum, except where the substratum is loamy. In such places, there are free carbonates below a depth of 40 inches. In most pedons there are no coarse fragments, but in some pedons, pebbles make up 10 to 15 percent of the solum.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The Bw horizon and BC horizon have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 4 to 8. In the loamy substratum phase, very fine sandy loam, loam, or silt loam is below a depth of 40 inches. These loamy deposits have hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. Coarse fragments in the loamy substratum make up as much as 10 percent of the substratum in some pedons. In the wet

substratum phase, there are mottles below a depth of 40 inches.

## Poy Series

The Poy series consists of poorly drained soils in depressions in glacial lake basins. The permeability of Poy soils is slow or very slow over rapid. These soils formed mainly in clayey water-laid deposits underlain by sand. The slope ranges from 0 to 2 percent.

The Poy soils commonly are adjacent on the landscape to Borth and Menasha soils. Borth soils are moderately well drained and are higher on the landscape than the Poy soils. Menasha soils are in positions on the landscape similar to those of the Poy soils. Menasha soils are clayey throughout.

Typical pedon of Poy clay loam, approximately 1,480 feet south and 75 feet east of the northwest corner of sec. 33, T. 21 N., R. 14 E.

- Ap—0 to 10 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; firm; many roots; neutral; abrupt smooth boundary.
- Bg1—10 to 16 inches; dark gray (5Y 4/1) clay; few medium prominent strong brown (7.5YR 5/8) mottles; strong fine angular blocky structure; firm; common roots; neutral; clear wavy boundary.
- Bg2—16 to 25 inches; gray (5Y 6/1) clay; many medium prominent strong brown (7.5YR 5/6) mottles; strong fine angular blocky structure; firm; neutral; clear wavy boundary.
- Bg3—25 to 27 inches; gray (5Y 5/1) clay; few medium prominent strong brown (7.5YR 5/6) mottles; massive; firm; neutral; abrupt wavy boundary.
- 2Cg—27 to 60 inches; grayish brown (10YR 5/2) sand; common medium prominent strong brown (7.5YR 5/8) mottles; single grained; loose; mildly alkaline.

The thickness of the solum and the depth to underlying sand ranges from 20 to 36 inches. Reaction is neutral or mildly alkaline in the solum. It is neutral to moderately alkaline in the substratum. In some pedons there are free carbonates in the lower part of the clayey deposits.

The Ap horizon has a value of 2 or 3 and chroma of 0 or 1. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 6, and chroma of 1 or 2. It is silty clay or clay. The 2Cg horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is sand or fine sand.

## Richford Series

The Richford series consists of somewhat excessively drained soils on outwash plains and stream terraces. The permeability of Richford soils is moderately rapid over rapid. These soils formed in sandy and loamy

deposits underlain by sand or gravelly sand. The slope ranges from 0 to 12 percent.

The Richford soils commonly are adjacent on the landscape to the Kranski, Plainfield, and Rosholt soils. Unlike Richford soils, the Kranski soils are sandy throughout and are on moraines and drumlins. The Plainfield and Rosholt soils are in positions on the landscape similar to those of the Richford soils. The Plainfield soils are sandy throughout, and the Rosholt soils have a sandy loam A horizon and a B horizon that is finer textured than that of the Richford soils.

Typical pedon of Richford loamy sand, 2 to 6 percent slopes, approximately 660 feet north and 1,300 feet east of the southwest corner of sec. 15, T. 23 N., R. 12 E.

- Ap—0 to 7 inches; dark brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak medium granular structure; very friable; common roots; about 4 percent pebbles; medium acid; abrupt smooth boundary.
- E—7 to 21 inches; brown (7.5YR 4/4) loamy sand, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure; very friable; few roots; about 4 percent pebbles and 3 percent cobbles; medium acid; clear wavy boundary.
- Bt1—21 to 27 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; few roots; continuous moderately thick clay films on faces of peds; about 10 percent pebbles; medium acid; clear wavy boundary.
- Bt2—27 to 31 inches; brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; few roots; continuous thin clay films on faces of peds; about 7 percent pebbles; medium acid; clear wavy boundary.
- Bt3—31 to 38 inches; brown (7.5YR 4/4) loamy sand; weak coarse subangular blocky structure; very friable; few roots; clay bridging of sand grains; about 10 percent pebbles and 3 percent cobbles; medium acid; clear wavy boundary.
- C—38 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grained; loose; about 25 percent pebbles and 5 percent cobbles; slightly acid.

The solum is 30 to 48 inches thick. It is slightly acid or medium acid. The substratum is slightly acid or neutral. Pebbles and cobbles make up 5 to 15 percent of the solum; the highest percentage is in the subsoil. The substratum is 10 to 30 percent pebbles and cobbles.

The Ap horizon has value and chroma of 2 or 3. The E horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is loamy sand or sand. In some pedons there is a horizon that has colors similar to those of a spodic horizon, but the content of organic carbon, iron, and aluminum is too low to meet the requirements for a spodic horizon. The Bt horizon commonly is loamy sand but has some subhorizons that are sandy loam.

The C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6.

## Roscommon Series

The Roscommon series consists of poorly drained soils in drainageways and depressions, on outwash plains, and in glacial lake basins. These soils are rapidly permeable. They formed in sand. The slope ranges from 0 to 2 percent.

The Roscommon soils commonly are adjacent on the landscape to Cathro, Markey, Meehan, and Wainola soils. Cathro and Markey soils formed in 16 to 51 inches of muck. They are very poorly drained. Both soils are lower on the landscape than the Roscommon soils. Meehan and Wainola soils are somewhat poorly drained. They are higher on the landscape than the Roscommon soils. Wainola soils formed in fine sand.

Typical pedon of Roscommon loamy sand, approximately 2,540 feet north and 2,500 feet west of the southeast corner of sec. 23, T. 23 N., R. 12 E.

- Ap—0 to 9 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak medium granular structure; very friable; common roots; slightly acid; abrupt smooth boundary.
- Cg1—9 to 16 inches; grayish brown (10YR 5/2) sand; few medium faint brown (10YR 5/3) mottles; single grained; loose; neutral; gradual wavy boundary.
- Cg2—16 to 60 inches; dark gray (10YR 4/1) sand; single grained; loose; neutral.

Reaction is slightly acid to mildly alkaline throughout. Pebbles make up 0 to 10 percent of the upper 40 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. In some undisturbed pedons, as much as 10 inches of the surface is muck. The Cg horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 1 or 2.

## Rosholt Series

The Rosholt series consists of well drained soils on outwash plains and stream terraces. The permeability of Rosholt soils is moderately rapid over very rapid. These soils formed in loamy and sandy deposits underlain by stratified sand and gravel. The slope ranges from 0 to 30 percent.

The Rosholt soils commonly are adjacent on the landscape to Kennan and Richford soils. Kennan soils formed in loamy glacial till. They are on moraines and drumlins and are well drained. Richford soils are in positions on the landscape similar to those of the Rosholt soils. Richford soils are somewhat excessively drained; they are sandy in the upper part of the solum.

Typical pedon of Rosholt sandy loam, 2 to 6 percent slopes, approximately 900 feet north and 1,360 feet west of the southeast corner of sec. 1, T. 23 N., R. 11 E.

- Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; common roots; about 4 percent pebbles; neutral; abrupt smooth boundary.
- E—7 to 11 inches; brown (10YR 5/3) sandy loam, very pale brown (10YR 7/3) dry; weak thick platy structure; very friable; common roots; about 4 percent pebbles; slightly acid; clear wavy boundary.
- E/B—11 to 18 inches; brown (10YR 5/3) sandy loam, very pale brown (10YR 7/3) dry (E); weak thick platy structure; very friable; about 80 percent tongues extending into and surrounding dark yellowish brown (10YR 4/4) loam (Bt); weak medium subangular blocky structure; friable; few roots; few thin discontinuous clay films on faces of peds (Bt); about 12 percent pebbles; slightly acid; clear wavy boundary.
- Bt1—18 to 26 inches; dark brown (7.5YR 4/4) loam; weak medium subangular blocky structure; friable; few roots; moderately thick continuous clay films on faces of peds; many coatings of brown (10YR 5/3) E horizon material on surfaces of peds; about 12 percent pebbles; medium acid; clear wavy boundary.
- Bt2—26 to 30 inches; dark brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; friable; few roots; few thin continuous clay films on faces of peds; about 12 percent pebbles; medium acid; clear wavy boundary.
- 2BC—30 to 35 inches; brown (7.5YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; about 5 percent pebbles; medium acid; clear wavy boundary.
- 2C—35 to 60 inches; light yellowish brown (10YR 6/4) stratified sand and gravel; single grained; loose; about 30 percent pebbles and 5 percent cobbles; slightly acid.

The solum is 24 to 40 inches thick. Reaction is slightly acid to strongly acid in the solum and substratum. Pebbles make up 2 to 20 percent of the upper part of the solum and 10 to 40 percent of the lower part. Coarse fragments make up 15 to 70 percent of the substratum. They are mainly pebbles; 5 to 15 percent are cobbles.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The E horizon has value of 4 or 5 and chroma of 2 or 3. Rosholt soils have an E/B or B/E horizon, or both. The Bt1 and Bt2 horizons have hue of 10YR, 7.5YR, or 5YR; value is 4 or 5; and chroma is 3 or 4. The horizons are sandy loam or loam. The 2BC horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is loamy sand or gravelly loamy sand.

## Rousseau Series

The Rousseau series consists of moderately well drained soils on old lake beaches that are associated with glacial lake basins. These soils are rapidly permeable. They formed in fine sand. The slope ranges from 0 to 3 percent.

The Rousseau soils commonly are adjacent to Shawano and Wainola soils. Shawano soils are excessively drained and are higher on the landscape than the Rousseau soils. Wainola soils are somewhat poorly drained and are lower on the landscape.

Typical pedon of Rousseau loamy fine sand, 0 to 3 percent slopes, approximately 2,400 feet south and 75 feet east of the northwest corner of sec. 10, T. 21 N., R. 14 E.

- Ap—0 to 8 inches; dark grayish brown (10YR 3/3) loamy fine sand, pale brown (10YR 6/3) dry; weak very fine subangular blocky structure; very friable; few roots; slightly acid; abrupt smooth boundary.
- Bs1—8 to 19 inches; brown (7.5YR 4/4) fine sand; weak medium subangular blocky structure; very friable; few roots; slightly acid; gradual wavy boundary.
- Bs2—19 to 30 inches; yellowish red (5YR 4/6) fine sand; weak medium subangular blocky structure; very friable; few roots; neutral; gradual wavy boundary.
- C1—30 to 37 inches; brown (7.5YR 5/4) fine sand; few medium distinct yellowish red (5YR 4/6) mottles; single grained; loose; slightly acid; gradual wavy boundary.
- C2—37 to 43 inches; strong brown (7.5YR 5/6) and light brown (7.5YR 6/4) fine sand; few fine distinct red (2.5YR 4/6) mottles; single grained; loose; slightly acid; gradual wavy boundary.
- C3—43 to 60 inches; strong brown (7.5YR 5/6) fine sand; common medium prominent pinkish gray (7.5YR 6/2) and few fine prominent red (2.5YR 5/8) mottles; single grained; loose; slightly acid.

The solum is 24 to 32 inches thick. Reaction is medium acid or slightly acid in the solum and substratum.

The Ap horizon has value of 2 or 3 and chroma of 2 or 3. It is 1 to 4 inches thick. The B horizon has value and chroma of 4 to 6. The C horizon has value of 5 or 6 and chroma of 4 to 6. In some pedons there are no mottles with chroma of 2 or less within a depth of 60 inches.

## Seelyeville Series

The Seelyeville series consists of very poorly drained soils in depressions on moraines and on the flood plains. These soils are moderately rapidly permeable. They formed in more than 51 inches of organic deposits. The slope ranges from 0 to 2 percent.

The Seelyeville soils are similar to and commonly are adjacent to Cathro, Loxley, and Markey soils. These soils and the Seelyeville soils are in similar positions on the landscape. Cathro and Markey soils have mineral material within a depth of 51 inches. Loxley soils are more acid than the Seelyeville soils. They have sphagnum moss on the surface.

Typical pedon of Seelyeville muck, approximately 150 feet north and 600 feet west of the southeast corner of sec. 21, T. 24 N., R. 14 E.

Oa1—0 to 28 inches; black (10YR 2/1) broken face, rubbed, and pressed sapric material; about 10 percent fiber, less than 5 percent rubbed; weak very fine granular structure; common roots; medium acid; clear wavy boundary.

Oa2—28 to 42 inches; black (10YR 2/1) broken face, rubbed, and pressed sapric material; about 10 percent fiber, less than 5 percent rubbed; weak fine granular structure; medium acid; clear wavy boundary.

Oa3—42 to 56 inches; black (10YR 2/1) broken face, rubbed, and pressed sapric material; about 10 percent fiber, less than 5 percent rubbed; weak very fine subangular blocky structure; medium acid; clear wavy boundary.

Oa4—56 to 60 inches; black (10YR 2/1) broken face, rubbed, and pressed sapric material; about 10 percent fiber, less than 5 percent rubbed; weak fine subangular blocky structure; medium acid.

The organic material is more than 51 inches thick. It is mainly herbaceous, but in some pedons it is 5 to 10 percent woody fragments. Reaction is medium acid to neutral throughout.

The sapric material is neutral or has hue of 10YR; the value is 2 or 3, and chroma is 1 or 2. In some pedons, there are thin layers of hemic material less than 10 inches thick. The hemic material has value and chroma of 2 or 3.

## Shawano Series

The Shawano series consists of excessively drained soils on old lake beaches that are associated with glacial lake basins. These soils are rapidly permeable. They formed in fine sand. The slope ranges from 2 to 20 percent.

The Shawano soils are similar to Plainfield and Rousseau soils and commonly are adjacent to Plainfield, Rousseau, Tustin, and Wainola soils. Plainfield soils and the Shawano soils are in similar positions on the landscape, but Plainfield soils formed in coarser sand. Rousseau and Tustin soils are slightly lower on the landscape than Shawano soils. Rousseau soils are moderately well drained. Tustin soils are well drained; they have 20 to 36 inches of sandy deposits over a loamy and clayey B horizon and a sandy C horizon.

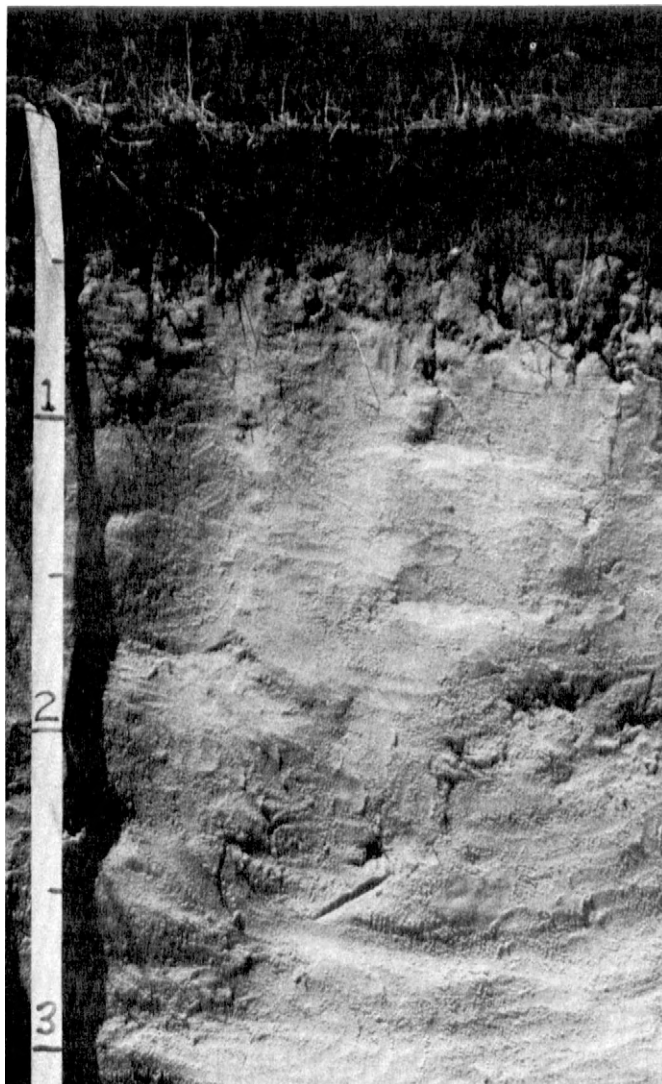


Figure 11.—Profile of Shawano loamy fine sand, 2 to 6 percent slopes. The scale is in feet.

Wainola soils are lower on the landscape than Shawano soils and are somewhat poorly drained.

Typical pedon of Shawano loamy fine sand, 2 to 6 percent slopes (fig. 11), approximately 1,900 feet north and 300 feet east of the southwest corner of sec. 23, T. 21 N., R. 14 E.

Ap—0 to 7 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak medium granular structure; very friable; few roots; slightly acid; abrupt smooth boundary.

Bw1—7 to 20 inches; strong brown (7.5YR 5/6) fine sand; weak coarse subangular blocky structure; very friable; slightly acid; clear wavy boundary.

Bw2—20 to 29 inches; brown (7.5YR 5/4) fine sand; single grained; loose; slightly acid; gradual wavy boundary.

C—29 to 60 inches; light brown (7.5YR 6/4) fine sand; single grained; loose; slightly acid.

The solum is 18 to 30 inches thick. Reaction is slightly acid or medium acid in the solum and substratum. Pebbles make up 0 to 2 percent of the C horizon.

The Ap horizon has hue of 7.5YR or 10YR and value and chroma of 2 to 4. The Bw horizon has value and chroma of 4 to 6. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 4 to 6. In some pedons there are thin discontinuous strata of sand below a depth of 40 inches.

### Symco Series

The Symco series consists of somewhat poorly drained soils in drainageways and slight depressions on moraines. These soils are moderately slowly permeable. They formed in loamy deposits and in loamy glacial till. The slope ranges from 0 to 3 percent.

The Symco soils commonly are adjacent on the landscape to Angelica, Hortonville, and Tilleda soils. The Angelica soils are poorly drained and are lower on the landscape than the Symco soils. The Hortonville and Tilleda soils are well drained; they are in higher positions on the landscape.

Typical pedon of Symco loam, 0 to 3 percent slopes, approximately 90 feet south and 1,300 feet west of the northeast corner of sec. 14, T. 23 N., R. 13 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; common roots; neutral; abrupt smooth boundary.

Bt—8 to 12 inches; dark brown (7.5YR 4/4) clay loam; common medium prominent strong brown (7.5YR 5/6) and common fine prominent dark grayish brown (10YR 4/2) mottles; moderate fine angular blocky structure; firm; few roots; many faint dark brown (7.5YR 4/4) clay films on faces of peds; about 2 percent pebbles; neutral; clear wavy boundary.

Bt2—12 to 21 inches; reddish brown (5YR 4/4) clay loam; common medium prominent strong brown (7.5YR 5/6) and many medium prominent dark grayish brown (10YR 4/2) mottles; moderate fine angular blocky structure; firm; few roots; many faint reddish brown (5YR 4/3) clay films on faces of peds; about 4 percent pebbles; neutral; clear wavy boundary.

Bt3—21 to 26 inches; reddish brown (5YR 4/4) clay loam; common medium prominent strong brown (7.5YR 5/6) and few small prominent dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure; firm; few roots; few faint reddish brown (5YR 4/3) clay films in pores;

about 3 percent pebbles and 1 percent cobbles; mildly alkaline; clear wavy boundary.

C—26 to 60 inches; reddish brown (5YR 4/4) clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; about 4 percent pebbles and 1 percent cobbles; few fine light gray (10YR 7/2) soft lime accumulations; slight effervescence; moderately alkaline.

The solum is 24 to 32 inches thick. It is slightly acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline. Free carbonates commonly are at a depth of 24 to 32 inches. Pebbles and cobbles make up 0 to 10 percent of the solum and substratum.

The Ap horizon has a value of 2 or 3 and chroma of 1 or 2. The Bt horizon commonly is loam, clay loam, or silty clay loam. The C horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is loam or clay loam.

### Tilleda Series

The Tilleda series consists of well drained soils on moraines. These soils are moderately permeable. They formed in loamy glacial till. The slope ranges from 2 to 12 percent.

The Tilleda soils are similar to the Hortonville soils and commonly are adjacent on the landscape to Kennan and Symco soils. The Hortonville and Kennan soils and the Tilleda soils are in similar positions on the landscape. The Kennan soils have less clay in the A and B horizons than the Tilleda soils. The Hortonville soils have free carbonates at a shallower depth than the Tilleda soils. Symco soils are somewhat poorly drained. They are lower on the landscape than the Tilleda soils.

Typical pedon of Tilleda loam, 2 to 6 percent slopes, approximately 940 feet north and 1,040 feet west of the southeast corner of sec. 32, T. 22 N., R. 12 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; common roots; medium acid; abrupt smooth boundary.

E/B—8 to 10 inches; brown (10YR 5/3) loam, very pale brown (10YR 7/3) dry (E); weak medium subangular blocky structure; very friable; about 70 percent tongues extending into and surrounding dark brown (7.5YR 4/4) loam (Bt); friable; few thin discontinuous clay films on faces of peds (Bt); common roots; medium acid; clear irregular boundary.

B/E—10 to 16 inches; dark brown (7.5YR 4/4) loam (Bt) in about 60 percent of the horizon; moderate fine subangular blocky structure; friable; few thin discontinuous clay films on faces of peds (Bt); tongues of brown (10YR 5/3) loam, very pale brown (10YR 7/3) dry, (E) extending to bottom of the

- horizon; very friable; few roots; about 4 percent pebbles; medium acid; clear wavy boundary.
- Bt1—16 to 26 inches; reddish brown (5YR 4/4) clay loam; strong fine angular blocky structure; firm; few roots; moderately thick continuous clay films on faces of peds; brown (10YR 5/3) coatings (E) are on vertical faces of peds in the upper part; about 5 percent pebbles; medium acid; clear wavy boundary.
- Bt2—26 to 36 inches; reddish brown (5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; many thick continuous clay films on faces of peds; about 4 percent pebbles; medium acid; clear wavy boundary.
- Bg3—36 to 44 inches; reddish brown (5YR 4/4) clay loam; weak coarse subangular blocky structure; firm; few thin discontinuous clay films on faces of peds; about 5 percent pebbles; slightly acid; clear wavy boundary.
- C—44 to 60 inches; reddish brown (5YR 5/4) loam; massive; friable; about 10 percent pebbles; neutral.

The solum is 40 to 50 inches thick. It is neutral to medium acid. The substratum is neutral or slightly acid. Pebbles make up 0 to 10 percent of the solum and 2 to 15 percent of the substratum.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. In some pedons there is an E horizon that has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 or 3. It is mixed with the Ap horizon in most cultivated areas. The E/B and B/E horizons have color and texture similar to those of the E and Bt horizons. The Bt horizon commonly is clay loam, but in some pedons, there are thin subhorizons of loam and sandy clay loam. The C horizon commonly is loam, but in some pedons, there are thin subhorizons of gravelly loam or clay loam.

## Tustin Series

The Tustin series consists of well drained soils in glacial lake basins. Permeability of Tustin soils is rapid over slow over rapid. These soils formed in sandy, loamy, and clayey deposits underlain by sand. The slope ranges from 2 to 6 percent.

Tustin soils commonly are adjacent to Borth, Nebago, and Plainfield soils. Borth and Tustin soils are in similar positions on the landscape. Borth soils formed in clay deposits underlain by sand. Nebago soils are somewhat poorly drained and are in lower positions on the landscape. Plainfield soils are sandy throughout. They are on outwash plains, stream terraces, and ground moraines.

Typical pedon of Tustin loamy sand, sandy substratum, 2 to 6 percent slopes, approximately 50 feet north and 1,600 feet east of the southwest corner of sec. 19, T. 21 N., R. 14 E.

- Ap—0 to 9 inches; dark brown (10YR 3/3) loamy sand, brown (10YR 5/3) dry; weak fine granular structure; very friable; many roots; medium acid; abrupt smooth boundary.
- Bw1—9 to 16 inches; brown (7.5YR 5/4) sand; weak coarse subangular blocky structure; very friable; few roots; slightly acid; clear wavy boundary.
- Bw2—16 to 28 inches; dark brown (7.5YR 4/4) sand; weak coarse subangular blocky structure; very friable; slightly acid; abrupt wavy boundary.
- Bt1—28 to 30 inches; reddish brown (5YR 4/4) sandy clay loam; moderate fine subangular blocky structure; firm; common thin continuous clay films on faces of peds; slightly acid; clear wavy boundary.
- 2Bt2—30 to 36 inches; reddish brown (5YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few thin continuous clay films on faces of peds; slightly acid; clear wavy boundary.
- 2Bt3—36 to 42 inches; reddish brown (5YR 4/4) clay; moderate fine angular blocky structure; few thin continuous clay films on faces of peds; firm; slightly acid; abrupt wavy boundary.
- 3C—42 to 60 inches; strong brown (7.5YR 5/6) sand; single grained; loose; slightly acid.

The solum is 30 to 50 inches thick. The upper part of the solum is sandy and is about 20 to 36 inches thick. The lower part is clayey and is about 12 to 24 inches thick. Reaction is neutral to medium acid in the upper part of the solum. It is neutral or slightly acid in the lower part and in the substratum. The depth to free carbonates is more than 40 inches.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6 and chroma of 3 or 4. It is sand or loamy sand. The 2Bt1 horizon commonly is sandy clay loam, but in some pedons it is sandy loam or loam. The 2Bt2 and 2Bt3 horizons have hue of 5YR or 7.5YR and value and chroma of 3 or 4. They are silty clay loam, silty clay, or clay. In some pedons, there is a thin 2C horizon that has hue of 7.5YR or 5YR and value and chroma of 4 or 5. It is clay, silty clay, or clay loam. The 3C horizon has hue of 5YR or 7.5YR and value and chroma of 4 to 6.

## Wainola Series

The Wainola series consists of somewhat poorly drained soils on outwash plains and in glacial lake basins. These soils are rapidly permeable. They formed in fine sand. The slope ranges from 0 to 2 percent.

The Wainola soils commonly are adjacent on the landscape to Roscommon and Shawano soils. The Roscommon soils are poorly drained and are in lower positions on the landscape than the Wainola soils. The Shawano soils are excessively drained and are in higher positions on the landscape.

Typical pedon of Wainola loamy fine sand, approximately 2,500 feet south and 660 feet east of the northwest corner of sec. 10, T. 21 N., R. 14 E.

- Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common roots; slightly acid; abrupt smooth boundary.
- Bs1—9 to 16 inches; brown (7.5YR 4/4) fine sand; common medium distinct light yellowish brown (10YR 6/4) and few fine prominent strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; very friable; few roots; strongly acid; clear wavy boundary.
- Bs2—16 to 25 inches; strong brown (7.5YR 5/6) fine sand; common medium prominent pinkish gray (7.5YR 6/2) and common fine distinct strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; very friable; few roots; strongly acid; clear wavy boundary.
- C1—25 to 36 inches; light gray (10YR 7/2) fine sand; many coarse prominent strong brown (7.5YR 5/8) mottles; single grained; loose; few roots; medium acid; gradual wavy boundary.
- C2—36 to 48 inches; brown (7.5YR 5/4) fine sand; few medium prominent light gray (10YR 7/2) mottles; single grained; loose; medium acid; gradual wavy boundary.
- C3—48 to 60 inches; light yellowish brown (10YR 6/4) fine sand; few fine distinct strong brown (7.5YR 5/6) mottles; single grained; loose; slightly acid.

The solum is 18 to 30 inches thick. The solum and the upper part of the substratum are strongly acid to slightly acid. The lower part of the substratum is slightly acid or medium acid.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. The Bs1 horizon has hue of 7.5YR or 10YR and value and chroma of 3 or 4. There are distinct or prominent mottles within this horizon. The Bs1 horizon commonly is fine sand, but in some pedons there are thin subhorizons of loamy fine sand. The Bs2 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. In some pedons, there are thin bands of loamy fine sand in the C horizon.

## Waupaca Series

The Waupaca series consists of poorly drained soils in depressions in glacial lake basins and on flood plains. These soils are moderately slowly permeable. They formed in silty water-laid deposits. The slope ranges from 0 to 2 percent.

The Waupaca soils commonly are adjacent on the landscape to Cathro, Markey, and Wega soils. Cathro and Markey soils formed in 16 to 50 inches of muck.

They are very poorly drained and are slightly lower on the landscape than the Waupaca soils. Wega soils are somewhat poorly drained. They are in drainageways and on low-lying flats.

Typical pedon of Waupaca silt loam, approximately 1,340 feet north and 1,340 feet east of the southwest corner of sec. 17, T. 25 N., R. 15 E.

- Ap—0 to 9 inches; very dark brown (10YR 2/2) silt loam, gray (10YR 5/1) dry; weak very fine subangular blocky structure; friable; few roots; mildly alkaline; abrupt smooth boundary.
- Cg11—9 to 13 inches; gray (10YR 5/1) silt, light gray (10YR 7/1) dry; common medium prominent yellowish brown (10YR 5/8) mottles; very fine stratification breaking to thin platy fragments; very friable; few roots; mildly alkaline; clear wavy boundary.
- Cg2—13 to 20 inches; light brownish gray (2.5Y 6/2) silt; common coarse prominent yellowish brown (10YR 5/8) mottles; very fine stratification breaking to thin platy fragments; very friable; mildly alkaline; clear wavy boundary.
- Cg3—20 to 25 inches; light brownish gray (2.5Y 6/2) silt; common coarse prominent light olive brown (2.5Y 5/6) mottles; very fine stratification breaking to thin platy fragments; very friable; mildly alkaline; clear wavy boundary.
- Cg4—25 to 30 inches; pinkish gray (7.5YR 6/2) silt; many coarse prominent strong brown (7.5YR 5/8) mottles; very fine stratification breaking to thin platy fragments; very friable; slight effervescence; mildly alkaline; clear wavy boundary.
- C—30 to 60 inches; yellowish brown (10YR 5/6), grayish brown (10YR 5/2), and brown (7.5YR 5/4) stratified silt and very fine sand; fine stratification breaking to thin platy fragments; very friable; violent effervescence; moderately alkaline.

Waupaca soils are neutral to moderately alkaline to a depth of about 40 inches and are mildly alkaline or moderately alkaline below that depth. The depth to free carbonates ranges from 15 to 40 inches.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Cg horizon has hue of 10YR, 2.5Y or 5Y, or it is neutral; it has value of 4 to 6 and chroma of 0 to 6. It commonly is stratified silt and very fine sand, but in some pedons there are thin strata of silt loam.

## Wega Series

The Wega series consists of somewhat poorly drained soils on low-lying flats and in drainageways in glacial lake basins. These soils are moderately slowly permeable. They formed in silty water-laid deposits. The slope ranges from 0 to 3 percent.

The Wega soils commonly are adjacent to Waupaca and Zurich soils. Waupaca soils are poorly drained and are lower on the landscape than the Wega soils. Zurich soils are moderately well drained and are in slightly higher positions on the landscape.

Typical pedon of Wega silt loam, 0 to 3 percent slopes, approximately 2,440 feet north and 2,540 feet east of the southwest corner of sec. 15, T. 25 N., R. 15 E.

- Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; many fine roots; mildly alkaline; abrupt smooth boundary.
- C1—9 to 13 inches; brown (7.5YR 5/4) silt loam; few fine prominent strong brown (7.5YR 5/8) mottles; very fine stratification breaking to thin platy fragments; friable; few fine roots; neutral; clear wavy boundary.
- C2—13 to 19 inches; strong brown (7.5YR 5/6) silt loam; few fine distinct strong brown (7.5YR 5/8) and few fine prominent pinkish gray (7.5YR 6/2) mottles; very fine stratification breaking to thin platy fragments; friable; few fine roots; neutral; clear wavy boundary.
- C3—19 to 60 inches; light brown (7.5YR 6/4) and reddish yellow (7.5YR 6/6) stratified silt and silt loam; few fine distinct pinkish gray (7.5YR 6/2) mottles; fine stratification breaking to thin platy fragments; very friable; violent effervescence; mildly alkaline.

Wega soils are neutral to moderately alkaline to a depth of about 40 inches and are mildly alkaline or moderately alkaline below that depth. The depth to free carbonates ranges from 15 to 40 inches.

The Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It commonly is stratified silt and silt loam, but in some pedons there are thin strata of very fine sand.

## Whalan Series

The Whalan series consists of moderately deep, well drained soils on glaciated uplands. These soils are moderately permeable. They formed in loamy deposits underlain by dolomitic limestone. The slope ranges from 2 to 12 percent.

The Whalan soils commonly are adjacent to Hortonville and Military soils. The Hortonville soils formed in loamy deposits on moraines and drumlins. Unlike the Whalan soils, they do not have bedrock within a depth of 60 inches. The Military soils are in positions on the landscape similar to those of the Whalan soils. The Military soils are underlain by sandstone bedrock.

Typical pedon of Whalan loam, 2 to 6 percent slopes, approximately 75 feet south and 2,310 feet east of the northwest corner of sec. 24, T. 21 N., R. 14 E.

- Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; common fine roots; about 2 percent pebbles; slightly acid; abrupt smooth boundary.
- Bt1—7 to 11 inches; reddish brown (5YR 4/4) loam; weak fine subangular blocky structure; friable; common fine roots; thin patchy clay films on faces of peds; about 5 percent pebbles; slightly acid; clear wavy boundary.
- Bt2—11 to 29 inches; reddish brown (5YR 4/4) clay loam; moderate fine angular blocky structure; firm; few roots; continuous thick clay films on faces of peds; about 5 percent pebbles; slightly acid; clear wavy boundary.
- BC—29 to 35 inches; reddish brown (5YR 4/4) loam; weak coarse subangular blocky structure; friable; few roots; about 5 percent pebbles and 2 percent cobbles; neutral; abrupt wavy boundary.
- R—35 inches; light gray (10YR 7/2) dolomite with few joints in the upper part.

The thickness of the solum and the depth to dolomite range from 20 to 40 inches. Reaction is medium acid to mildly alkaline in the solum. There are free carbonates in the BC horizon in some pedons. Pebbles and cobbles make up 0 to 8 percent of the upper part of the solum and 0 to 15 percent of the lower part.

The Ap horizon has value and chroma of 2 or 3. The Bt1 horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 4 to 6. The Bt2 horizon has hue of 7.5YR or 5YR. It is clay loam or loam. The BC horizon has hue of 7.5YR or 5YR and value and chroma of 4 to 6. It is loam, silt loam, or clay loam.

## Whalan Variant

The Whalan Variant consists of moderately deep, well drained soils on glaciated uplands. These soils are moderately permeable. They formed in sandy and loamy deposits underlain by dolomitic limestone. The slope ranges from 2 to 6 percent.

The Whalan Variant soils commonly are adjacent on the landscape to Hortonville, Military, and Whalan soils. The Hortonville soils formed in loamy deposits on drumlins and moraines. Unlike the Whalan Variant soils, Hortonville soils do not have bedrock within a depth of 60 inches. The Military and Whalan soils and the Whalan Variant soils are in similar positions on the landscape. The Military soils are underlain by sandstone bedrock. The Whalan soils are finer textured in the A horizon and in the upper part of the B horizon than the Whalan Variant soils.

Typical pedon of Whalan Variant loamy fine sand, 2 to 6 percent slopes, approximately 2,000 feet south and 750 feet east of the northwest corner of sec. 14, T. 21 N., R. 14 E.

- Ap—0 to 11 inches; dark brown (10YR 3/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; few fine roots; slightly acid; abrupt smooth boundary.
- BE—11 to 15 inches; reddish yellow (7.5YR 6/6) and brownish yellow (10YR 6/6) loamy fine sand; weak medium subangular blocky structure; very friable; few fine roots; slightly acid; abrupt wavy boundary.
- 2Bt—15 to 24 inches; reddish brown (5YR 4/4) silty clay loam; moderate fine angular blocky structure; firm; few fine roots; moderately thick continuous clay films on faces of peds; about 2 percent pebbles; slightly acid; abrupt wavy boundary.
- R—24 inches; light gray (10YR 7/2) dolomite.

The thickness of the solum and the depth to dolomite range from 20 to 40 inches. The sandy part of the solum is 12 to 24 inches thick. Reaction is medium acid to neutral in the upper part of the solum and slightly acid to mildly alkaline in the lower part. Pebbles and cobbles make up 0 to 5 percent of the upper part of the solum and 0 to 15 percent of the lower part.

The Ap horizon has value and chroma of 2 to 4. The BE horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. The 2Bt horizon has value of 3 to 5. It is silty clay loam or clay loam.

## Zurich Series

The Zurich series consists of moderately well drained soils in glacial lake basins. These soils are moderately permeable. They formed in silty water-laid deposits underlain by stratified very fine sandy loam and silt loam. The slope ranges from 2 to 6 percent.

These soils have interfingering of the E horizon into the Bt horizon, which is not typical for the Zurich series. This difference, however, does not affect the use or behavior of the soils.

The Zurich soils commonly are adjacent on the landscape to Borth, Oshkosh, Tustin, and Wega soils. Borth, Oshkosh, and Tustin soils and the Zurich soils are in similar positions on the landscape. Borth soils formed in clay deposits underlain by sand. Oshkosh soils have clayey B and C horizons. Tustin soils have 20 to 36 inches of sandy deposits over a loamy and clayey B horizon and a sandy C horizon. Wega soils are somewhat poorly drained and are slightly lower on the landscape than the Zurich soils.

Typical pedon of Zurich silt loam, 2 to 6 percent slopes, approximately 660 feet north and 1,300 feet west of the southeast corner of sec. 35, T. 21 N., R. 13 E.

- Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; very friable; few roots; slightly acid; abrupt smooth boundary.
- B/E—7 to 9 inches; brown (7.5YR 5/4) silt loam (Bt) in about 70 percent of the horizon; weak medium subangular blocky structure; very friable; few thin discontinuous clay films on faces of peds (Bt); interfingering of pale brown (10YR 6/3) very fine sandy loam (E) extends to bottom of horizon; very friable; few roots; slightly acid; clear wavy boundary.
- Bt—9 to 16 inches; dark brown (7.5YR 4/4) silt loam; weak fine subangular blocky structure; friable; few roots; continuous thin clay films on faces of peds; few pale brown (10YR 6/3) coatings of E horizon material on vertical faces of peds in the upper part of horizon; slightly acid; clear wavy boundary.
- BC—16 to 20 inches; dark brown (7.5YR 4/4) silt loam; weak medium subangular blocky structure; friable; few roots; mildly alkaline; clear wavy boundary.
- C1—20 to 25 inches; brown (7.5YR 5/4) silt loam; many fine prominent strong brown (7.5YR 5/8) mottles; weak thin platy fragments; very friable; few roots; high percentage of coarse silt; mildly alkaline; clear wavy boundary.
- C2—25 to 26 inches; brownish yellow (10YR 6/6) very fine sandy loam; many fine distinct yellowish red (5YR 5/8) mottles; weak thin platy fragments; very friable; mildly alkaline; abrupt wavy boundary.
- C3—26 to 60 inches; dark brown (7.5YR 4/4) stratified silt loam and very fine sandy loam; common fine prominent yellowish red (5YR 5/8) mottles; fine stratification breaking to thin platy fragments; very friable; strata of silt loam and very fine sandy loam range in thickness from 1/2 inch to 8 inches; strong effervescence; mildly alkaline.

The solum is 18 to 36 inches thick. It is slightly acid to mildly alkaline. The substratum is mildly alkaline or moderately alkaline. Free carbonates commonly are at a depth of less than 30 inches, but in some pedons, they are at a depth of 40 inches.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. In some pedons there is an E horizon, which has hue of 10YR, value of 4 to 6, and chroma of 2 or 3. The B/E horizon has interfingering of E horizon material that penetrates the Bt horizon primarily along vertical faces of the peds. Color and texture are similar to those of the E and Bt1 horizons. The Bt1 horizon is silt loam or silty clay loam. The BC horizon is very fine sandy loam or silt loam. The C horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. It commonly is stratified very fine sandy loam and silt loam, but in some pedons there are strata of very fine sand.

# Formation of the Soils

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In this section, the factors of soil formation as they relate to the soils in Waupaca County are described, and the processes of horizon differentiation are explained.

## Factors of Soil Formation

Soil is formed by the interaction of outside processes on accumulated or deposited geologic materials. The characteristics of a soil are determined by the physical and mineralogical composition of the *parent material*, the *climate* in the area since the parent material accumulated, the *plant and animal life* in and on the soil, the *relief*, or lay of the land, and the length of *time* the processes of soil development have acted on the soil material.

The active factors of soil formation are climate and plant and animal life. They act on parent material and slowly change it into a natural body, or soil, that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of soil that can be formed. Finally, time is needed to change the parent material into a soil with horizons. Usually, a long period of time is needed for distinct horizons to develop.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of one factor unless conditions are specified for the other four. Many of the processes of soil development are not known.

## Parent Material

The parent material in Waupaca County consists of windblown sand, water-laid deposits, organic material, and glacial drift. Glacial drift can be further divided into till and outwash.

Till is unsorted glacial debris composed of clay, silt, sand, gravel, and boulders. Three distinctly different types of till occur in the county. They were all deposited during the Wisconsin Glaciation but were deposited in different time periods, which are known as substages (7). The major substages are Cary and Valders. During each substage, glacial debris was deposited and formed hills, valleys, depressions, and broad flats.

Two separate advances of the Cary substage deposited till in the county. The till deposited by the earlier of these advances in the southwestern part of Waupaca County is distinguished by its dark brown color

and sand or loamy sand texture. Prominent ridges, irregular hills, and kettle lakes are characteristic of the area. Large stones are common on the surface. The Kranski soils are the major soils that formed in this till. The later deposit of Cary till, in the northwestern part of the county, is distinguished by its brown and reddish brown color and loamy sand or sandy loam texture. Prominent ridges, irregular hills, and wet depressions are characteristic of the area. Large boulders are common on the surface. In some areas, boulders are so numerous that tillage is impractical. The Kennan soils are the major soils that formed in this till.

The Valders substage overrode the Cary tills in the central part of the county. The Valders till is distinguished by its reddish brown color and loam or clay loam texture. It is highly calcareous. The topography in this area consists mostly of long, gentle slopes. Surface stones are less common in this till than in the Cary tills. The major soils that formed in Valders till are Hortonville, Symco, and Tilleda soils.

The thickness of the till throughout the county ranges from a trace to more than 150 feet. The major soils that formed in a thin layer of till over dolomite bedrock are the Military and Whalan soils. These soils are in the southeastern part of the county and are not extensive. The topography is determined by the underlying dolomite. The soils are mostly gently sloping. There is an escarpment of dolomite along nearly all of the western edge of the area of these soils.

The melt waters of the receding ice masses deposited sand or sand and gravel in the form of stream terraces, eskers, kames, and outwash plains. The areas are mostly nearly level, but the range is too steep. Gravel and cobbles are common on the surface in some areas. The major soils that formed in outwash are Plainfield, Richford, and Rosholt soils.

Water-laid deposits are accumulations of stratified fine sand, silt, or clay in glacial lakes. The lakes formed when ice blocked the drainage outlet. The largest glacial lake basin in the county extends from the east county line to the city of Waupaca and from the south county line near Fremont to the north county line near Embarrass. The topography of this lake basin is mostly nearly level and gently sloping, but it has many wet depressions. The basins are generally free of stones. The major soils that formed in water-laid deposits are Neenah, Oshkosh, Wega, and Zurich soils.

Within the glacial lake basins there are areas of windblown sand. This sand was originally deposited as beaches. As the lakes dried, the winds shifted the sand and formed dunes. The deposits of windblown sand are fine and are mostly gently sloping or sloping. The major soils that formed in windblown sand are Rousseau, Shawano, and Wainola soils. In some places this sand was blown over clayey water-laid deposits. The soils that formed in a thin mantle of sand over clay are Nebago and Tustin soils.

Organic material has accumulated in wet depressions throughout the county. The material consists of partly decomposed reeds, sedges, grasses, and trees. The topography is nearly level. The major soils that formed in organic material are Cathro, Markey, and Seelyeville soils.

### Climate

In general, climate affects soil formation through the moisture and heat it contributes to the environment. It directly affects the weathering of rocks. It also alters parent material through the mechanical action of freezing and thawing. The leaching by water also affects the movement of minerals and clay in soils. Climate also indirectly affects soil formation through its influence on plant and animal life.

The climate is nearly the same throughout Waupaca County and has caused few differences in soil formation. The county, however, is in a climatic zone where the upper part of the soil has horizons like those in soils farther to the north, and the lower part has horizons that are similar to those in soils farther to the south.

### Plant and Animal Life

Plants and animals affect the formation of soils by providing organic matter and by transferring plant nutrients from the lower layers of the soil to the upper layers.

Most of the soils in Waupaca County formed under deciduous vegetation. Soils that formed under forest vegetation have a very thin, moderately dark surface layer. Those soils are classified as Alfisols and are exemplified by the Hortonville, Kennan, and Rosholt series. A few of the soils in the county formed under grass vegetation. Those soils have a thick, dark surface layer. They are classified as Mollisols and are exemplified by the Menasha and Poy series. Many soils in the county formed under both grass and forest vegetation. Those soils have a moderately thick, moderately dark surface layer. They are exemplified by the Neenah, Roscommon, and Symco series.

Man's activities have had an important but very recent influence on the soils in the county. Man has greatly altered the original condition of the soils by clearing the native vegetation and mixing the upper soil layers by cultivation. He has planted crops, which are different from the native vegetation. He has drained large areas

of wet soils. He has overcultivated the soils with heavy equipment that has caused the loss of organic matter; compaction; and, on some soils, erosion of the surface layer. Examples of this erosion are evident in the sloping or moderately steep Hortonville soils and in the sloping Tilleda and Whalan soils. Some of the effects of man's activities, such as additions of fertilizer and pesticides, may not be known for many years.

### Relief

The relief in Waupaca County is largely attributed to glacial activity. The relief ranges from steep in the morainic areas to nearly level on bottom lands and in depressions. Relief influences soil formation by controlling drainage, runoff, and other direct and indirect effects of water, including erosion. The natural drainage of soils is determined mostly by relief and by the position of the soils on the landscape.

In the lower depressional areas, soils remain cool and wet; as a result, the mineral soils are poorly drained and are gleyed. Examples of poorly drained mineral soils are Menasha and Poy soils. The decomposition of the organic matter in the soils is slow; therefore, the mineral soils have developed a thick surface layer that is high in organic matter content.

Neenah and Oesterle soils are examples of soils that are somewhat poorly drained and that are in drainageways. The soils receive runoff from the higher areas and remain wet during part of the growing season. They are mottled in the subsoil and substratum.

Runoff is faster on soils that formed in more sloping areas. Consequently, less water enters the soil. Examples of soils on slopes are the well drained Hortonville, Kennan, and Rosholt soils. Such soils generally do not have mottling and prolonged seasonal wetness, and they have developed more distinct horizonation than wet soils.

### Time

Time is needed for the other factors of soil formation to act on the parent material and change it into soil. Soils may have a profile with distinct horizons, a profile with little or no horizonation, or a profile that is somewhere between, depending on the type of parent material and the length of time the soil-forming factors have been active.

Hortonville and Kennan soils have moderately distinct horizons and are considered to be strongly developed. Soils that formed in recent alluvium show little horizonation and are considered to be weakly developed. Fordum, Waupaca, and Wega soils are examples. The surface layer of these soils is the only distinct genetic horizon.

## Processes of Horizon Differentiation

A soil horizon may be defined as a layer of soil, approximately parallel to the soil surface, that has characteristics produced by the five soil-forming factors. These horizons are distinguished by characteristics that can be observed in the field. Horizon boundaries generally are not abrupt but grade from one horizon to another.

Horizonation is the product of one or more of the following processes: accumulation of organic matter, leaching of carbonates, translocation of silicate clay minerals, and reduction and transfer of iron.

Organic matter has accumulated in the surface layer of all of the soils in Waupaca County. The amount of organic matter and the thickness of the surface layer vary widely in the soils of the county. Plainfield and Shawano soils have a small amount of organic matter in the surface layer; Poy and Symco soils have a large amount. This difference is attributed to the ability of the soil to support vegetation and also to the type, amount, and rate of decomposition of vegetation.

Leaching of carbonates has occurred in almost all of the soils in the county. Water moving through the soil has dissolved the carbonates and carried them deeper into the soil or into the ground water. This leaching has had little visible effect on horizon development, but it is necessary prior to the translocation of silicate clay. Hortonville and Symco soils are examples of soils that have been leached of carbonates. The parent material of these soils is very high in carbonates, but the surface layer and subsoil have been leached of carbonates.

The translocation of silicate clay minerals has contributed to the development of the subsoil of many soils in the county. Silicate clay is moved from the surface horizon into the subsoil by downward percolating ground water. This clay accumulation is visible in the form of clay films on the surface of peds and in root canals. Soils that have had translocation of silicate clay

minerals generally have distinct subangular or angular blocky peds in the subsoil. Hortonville, Kennan, and Rosholt soils are examples of soils in which silicate clay translocation has occurred. These soils have more clay in the subsoil than in the horizons above the subsoil. In the sandy Plainfield and Shawano soils, however, there was little clay to move from the surface layer and so there has been no accumulation in the subsoil.

Wet soils, such as Menasha and Poy soils, are saturated during much of the year and so have little downward percolation of ground water. These soils have little or no translocated clay in their subsoil.

The reduction and transfer of iron has occurred in all of the poorly drained soils and in many of the somewhat poorly drained soils in the county. The iron oxides have been reduced and translocated by the water and organic matter in the soils. The depth of transfer may be within the horizon where it originated, or the iron may be completely removed from the soil profile. In most soils in the county, the process has stopped in the horizon of its origin or in the adjacent horizon. Menasha and Poy soils are examples of soils that have had intense reduction and transfer of iron, as is evidenced by the gleying, or gray colors, in the upper part of the subsoil. The reduction and transfer of iron in somewhat poorly drained soils, such as Neenah and Symco soils, has not been so intense as it has been in the wetter soils.

Gray spots called mottling are an indication of some reduction and transfer of iron that has occurred in the soils. These gray mottles, which are reduced iron, are mostly accompanied by segregated iron forms that are yellowish red, strong brown, or yellowish brown.

The processes of horizon differentiation have been active in all the soils in the county. The different processes that occurred in each soil determined the soil type and the degree of horizonation. The horizonation of the soils is one of the important characteristics that was considered in classifying and mapping the soils in Waupaca County.



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# Glossary

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	<i>Inches</i>
Very low.....	0 to 3
Low.....	3 to 6
Moderate.....	6 to 9
High.....	9 to 12
Very high.....	more than 12

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Blowout.** A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Clayey.** Clay, silty clay, or sandy clay.

**Climax vegetation.** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

**Coarse fragments.** If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

**Coarse textured soil.** Sand or loamy sand.

**Cobblestone (or cobble).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

**Complex, soil.** A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

**Compressible** (in tables). Excessive decrease in volume of soft soil under load.

**Conservation tillage.** A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Contour stripcropping.** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among

different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**Deferred grazing.** Postponing grazing or resting grazingland for a prescribed period.

**Depth, soil.** The depth to a root-impeding layer or horizon. In this publication it is depth to bedrock. The soil is considered deep if this depth is more than 40 inches and moderately deep if it is 20 to 40 inches.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained.*—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained.*—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained.*—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Drumlin.** A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

**Esker** (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

**Fast intake** (in tables). The rapid movement of water into the soil.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fine textured soil.** Sandy clay, silty clay, and clay.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Fragile** (in tables). A soil that is easily damaged by use or disturbance.

**Frost action** (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Glacial drift** (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

**Glacial lake basin.** Site of a lake formed during or shortly after glaciation by melting ice.

**Glacial outwash** (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

**Glacial till** (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and rock fragments transported and deposited by glacial ice.

**Gleyed soil.** Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

**Ground water** (geology). Water filling all the unblocked pores of underlying material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Hemic soil material (mucky peat).** Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow

represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

**O horizon.**—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

**A horizon.**—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

**E horizon.**—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

**B horizon.**—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

**C horizon.**—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

**R layer.**—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Intake rate.** The average rate of water entering the soil under irrigation. Most soils have a fast initial rate;

the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2.....	very low
0.2 to 0.4.....	low
0.4 to 0.75.....	moderately low
0.75 to 1.25.....	moderate
1.25 to 1.75.....	moderately high
1.75 to 2.5.....	high
More than 2.5.....	very high

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—*Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

**Kame** (geology). An irregular, short ridge or hill of stratified glacial drift.

**Kettle lake.** A body of water occupying a kettle in a pitted outwash plain or in a kettle moraine.

**Lacustrine deposit** (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

**Large stones** (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loamy.** Sandy loam, loam, clay loam, sandy clay loam.

**Low strength.** The soil is not strong enough to support loads.

**Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Miscellaneous area.** An area that has little or no natural soil and supports little or no vegetation.

**Moraine** (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size

measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Muck.** Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

**Munsell notation.** A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition. The classes are as follows:

	Percent
Very low.....	less than 0.5
Low.....	0.5 to 1.0
Moderately.....	1.0 to 2.0
Moderate.....	2.0 to 4.0
High.....	4.0 to 8.0
Very high.....	more than 8.0

**Organic soil.** A soil that contains 12 to 18 or more percent organic carbon (depending on content of mineral matter) and is more than 16 inches thick.

**Outwash, glacial.** Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

**Outwash plain.** A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Peat.** Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percs slowly** (in tables). The slow movement of water through the soil adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow.....	less than 0.06 inch
Slow.....	0.06 to 0.2 inch
Moderately slow.....	0.2 to 0.6 inch
Moderate.....	0.6 inch to 2.0 inches
Moderately rapid.....	2.0 to 6.0 inches
Rapid.....	6.0 to 20 inches
Very rapid.....	more than 20 inches

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping** (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity Index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Ponding.** Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

**Poorly graded.** Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Poor outlets** (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid.....	below 4.5
Very strongly acid.....	4.5 to 5.0
Strongly acid.....	5.1 to 5.5
Medium acid.....	5.6 to 6.0
Slightly acid.....	6.1 to 6.5
Neutral.....	6.6 to 7.3
Mildly alkaline.....	7.4 to 7.8
Moderately alkaline.....	7.9 to 8.4
Strongly alkaline.....	8.5 to 9.0
Very strongly alkaline.....	9.1 and higher

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-size particles.

**Sandy.** Sands or loamy sands.

**Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Site Index.** A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. Soils are described in terms that indicate the range in slope gradient:

	Percent
Nearly level.....	0 to 2
Gently sloping or undulating.....	2 to 6
Sloping or rolling.....	6 to 12
Moderately steep.....	12 to 20
Steep.....	20 to 30
Very steep.....	more than 30

**Slow Intake** (in tables). The slow movement of water into the soil.

**Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of

separates recognized in the United States are as follows:

	<i>Millime- ters</i>
Very coarse sand.....	2.0 to 1.0
Coarse sand.....	1.0 to 0.5
Medium sand.....	0.5 to 0.25
Fine sand.....	0.25 to 0.10
Very fine sand.....	0.10 to 0.05
Silt.....	0.05 to 0.002
Clay.....	less than 0.002

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Subsidence.** The settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either dessication and shrinkage or oxidation of organic material, or both, following drainage.

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** The part of the soil below the solum.

**Subsurface layer.** Any surface soil horizon (A, E, AB, EB) below the surface layer.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Surface soil.** The A, E, AB, and EB horizon. Includes all subdivisions of these horizons.

**Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer** (in tables). Otherwise suitable soil material too thin for the specified use.

**Till plain.** An extensive flat to undulating area underlain by glacial till.

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Varlant, soil.** A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

## Tables

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TABLE 1.--TEMPERATURE AND PRECIPITATION  
[Recorded in the period 1951-79 at Waupaca, Wisconsin]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
	<u>°F</u>	<u>°F</u>	<u>°F</u>	<u>°F</u>	<u>°F</u>		<u>In</u>	<u>In</u>	<u>In</u>		<u>In</u>
January----	24.4	5.0	14.7	46	-25	0	1.12	0.48	1.67	4	10.1
February---	30.0	9.0	19.5	50	-20	0	1.08	.40	1.66	4	9.1
March-----	40.4	20.1	30.3	67	-11	0	2.15	.89	3.21	6	11.3
April-----	57.1	33.7	45.4	85	14	40	3.03	1.72	4.18	7	1.9
May-----	70.7	44.3	57.5	91	26	262	3.95	2.30	5.42	7	.0
June-----	79.5	53.8	66.7	95	36	501	3.61	2.04	4.99	7	.0
July-----	83.8	58.6	71.2	97	43	657	3.56	2.28	4.70	7	.0
August-----	81.4	56.5	69.0	96	39	589	3.42	2.01	4.67	7	.0
September--	72.6	48.2	60.4	92	28	312	3.87	1.47	5.87	7	.0
October----	61.5	38.6	50.1	84	19	119	2.38	.76	3.70	5	.1
November---	43.9	25.9	34.9	69	1	6	1.83	.96	2.61	4	4.2
December---	29.9	13.1	21.5	53	-17	0	1.42	.62	2.09	5	10.8
Yearly:											
Average--	56.3	33.9	45.1	---	---	---	---	---	---	---	---
Extreme--	---	---	---	99	-25	---	---	---	---	---	---
Total----	---	---	---	---	---	2,486	31.42	25.93	36.65	70	47.5

\* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL  
[Recorded in the period 1951-79 at Waupaca, Wisconsin]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 29	May 12	May 28
2 years in 10 later than--	April 25	May 7	May 23
5 years in 10 later than--	April 17	April 28	May 13
First freezing temperature in fall:			
1 year in 10 earlier than--	October 5	September 25	September 15
2 years in 10 earlier than--	October 11	October 1	September 19
5 years in 10 earlier than--	October 23	October 11	September 28

TABLE 3.--GROWING SEASON  
[Recorded in the period 1951-79 at  
Waupaca, Wisconsin]

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F Days	Higher than 28° F Days	Higher than 32° F Days
9 years in 10	164	142	116
8 years in 10	173	150	123
5 years in 10	189	166	136
2 years in 10	204	181	150
1 year in 10	213	189	157

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ax	Angelica silt loam-----	18,085	3.7
BoB	Borth sandy loam, 1 to 4 percent slopes-----	1,860	0.4
BrB	Borth silty clay loam, 1 to 4 percent slopes-----	5,975	1.2
BxA	Borth-Nebago-Meehan complex, 0 to 3 percent slopes-----	1,495	0.3
Cm	Cathro and Markey mucks-----	31,955	6.6
EcC	Elderon-Rosholt complex, 6 to 12 percent slopes-----	2,710	0.6
EcD	Elderon-Rosholt complex, 12 to 30 percent slopes-----	7,185	1.5
Fa	Fordum loam-----	8,415	1.7
HnB	Hortonville fine sandy loam, 2 to 6 percent slopes-----	47,595	9.8
HrC2	Hortonville loam, 6 to 12 percent slopes, eroded-----	14,785	3.0
HrD2	Hortonville loam, 12 to 20 percent slopes, eroded-----	8,300	1.7
KbB	Kennan bouldery sandy loam, 2 to 6 percent slopes-----	18,065	3.7
KbC	Kennan bouldery sandy loam, 6 to 12 percent slopes-----	37,020	7.6
KbD	Kennan bouldery sandy loam, 12 to 30 percent slopes-----	18,085	3.7
KrB	Kranski loamy sand, 2 to 6 percent slopes-----	1,760	0.4
KrC	Kranski loamy sand, 6 to 12 percent slopes-----	1,675	0.3
KrD	Kranski loamy sand, 12 to 20 percent slopes-----	1,915	0.4
Lx	Loxley mucky peat-----	570	0.1
Mh	Meehan loamy sand-----	11,490	2.4
MLA	Meehan loamy sand, loamy substratum, 0 to 3 percent slopes-----	5,230	1.1
Mp	Menasha silty clay-----	1,690	0.3
MrB	Military loamy sand, 3 to 8 percent slopes-----	253	*
Ms	Minocqua mucky fine sandy loam-----	2,650	0.5
Ne	Nebago loamy sand, sandy substratum-----	1,750	0.4
NhA	Neenah silty clay, 0 to 3 percent slopes-----	1,660	0.3
OeA	Oesterle sandy loam, 0 to 3 percent slopes-----	6,940	1.4
OsB	Oshkosh silty clay loam, 2 to 6 percent slopes-----	1,510	0.3
Pe	Pits, gravel-----	256	*
PfA	Plainfield loamy sand, 0 to 2 percent slopes-----	3,665	0.8
PfB	Plainfield loamy sand, 2 to 6 percent slopes-----	16,940	3.5
PfC	Plainfield loamy sand, 6 to 12 percent slopes-----	9,325	1.9
PfD	Plainfield loamy sand, 12 to 30 percent slopes-----	5,590	1.1
PlB	Plainfield loamy sand, loamy substratum, 2 to 6 percent slopes-----	5,135	1.1
PmA	Plainfield loamy sand, wet substratum, 0 to 3 percent slopes-----	7,640	1.6
Pt	Poy clay loam-----	3,415	0.7
RfA	Richford loamy sand, 0 to 2 percent slopes-----	4,865	1.0
RfB	Richford loamy sand, 2 to 6 percent slopes-----	8,250	1.7
RfC	Richford loamy sand, 6 to 12 percent slopes-----	2,155	0.4
Rm	Roscommon loamy sand-----	10,525	2.2
RoA	Rosholt sandy loam, 0 to 2 percent slopes-----	4,785	1.0
RoB	Rosholt sandy loam, 2 to 6 percent slopes-----	26,990	5.5
RoC	Rosholt sandy loam, 6 to 12 percent slopes-----	8,645	1.8
RoD	Rosholt sandy loam, 12 to 20 percent slopes-----	4,360	0.9
RrB	Rosholt-Rock outcrop complex, 2 to 10 percent slopes-----	950	0.2
RsA	Rousseau loamy fine sand, 0 to 3 percent slopes-----	3,260	0.7
Sb	Seelyeville muck-----	11,005	2.3
SfB	Shawano loamy fine sand, 2 to 6 percent slopes-----	4,115	0.8
SfC	Shawano loamy fine sand, 6 to 12 percent slopes-----	3,120	0.6
SfD	Shawano loamy fine sand, 12 to 20 percent slopes-----	735	0.2
SyA	Symco loam, 0 to 3 percent slopes-----	40,565	8.3
TlB	Tilleda loam, 2 to 6 percent slopes-----	7,250	1.5
TlC2	Tilleda loam, 6 to 12 percent slopes, eroded-----	2,220	0.5
TuB	Tustin loamy sand, sandy substratum, 2 to 6 percent slopes-----	705	0.1
UdC	Udipsamments, undulating-----	1,050	0.2
Wa	Wainola loamy fine sand-----	4,800	1.0
Wd	Waupaca silt loam-----	4,910	1.0
WeA	Wega silt loam, 0 to 3 percent slopes-----	5,775	1.2
WhB	Whalan loam, 2 to 6 percent slopes-----	770	0.2
WhC2	Whalan loam, 6 to 12 percent slopes, eroded-----	346	0.1
WvB	Whalan Variant loamy fine sand, 2 to 6 percent slopes-----	595	0.1
ZzB	Zurich silt loam, 2 to 6 percent slopes-----	2,065	0.4
	Water-----	9,640	2.0
	Total-----	487,040	100.0

\* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Grass-legume hay*	Kentucky bluegrass	Soybeans
		<u>Bu</u>	<u>Tons</u>	<u>Bu</u>	<u>Tons</u>	<u>AUM**</u>	<u>Bu</u>
Ax----- Angelica	IIw	85	13	70	4.5	3.6	30
BoB, BrB----- Borth	IIe	90	15	70	4.0	3.1	28
BxA----- Borth-Nebago- Meehan	IIe	75	12	65	3.6	2.9	22
Cm----- Cathro and Markey	VIIw	---	---	---	---	---	---
EcC----- Elderon-Rosholt	VIIs	---	---	---	---	1.7	---
EcD----- Elderon-Rosholt	VIIIs	---	---	---	---	1.2	---
Fa----- Fordum	Vw	---	---	---	---	3.0	---
HnB----- Hortonville	IIe	100	16	75	5.0	4.1	35
HrC2----- Hortonville	IIIe	90	15	70	4.5	3.6	30
HrD2----- Hortonville	IVe	75	12	60	4.0	3.0	---
KbB***----- Kennan	IIe	85	13	75	4.5	3.6	29
KbC***----- Kennan	IIIe	75	12	70	4.5	3.3	25
KbD----- Kennan	VIIIs	---	---	---	---	2.9	---
KrB----- Kranski	IIIIs	70	12	65	3.5	1.8	28
KrC----- Kranski	IIIe	60	10	55	3.0	1.5	24
KrD----- Kranski	IVe	55	9	55	2.5	1.3	---
Lx----- Loxley	VIIw	---	---	---	---	---	---
Mh----- Meehan	IVw	50	8	50	2.5	1.3	23
MlA----- Meehan	IVw	55	9	55	3.0	1.5	26
Mp----- Menasha	IIw	90	14	70	4.5	4.0	32
MrB----- Military	IIe	90	14	80	4.3	3.2	30

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Grass-legume hay*	Kentucky bluegrass	Soybeans
		Bu	Tons	Bu	Tons	AUM**	Bu
Ms----- Minocqua	VIw	---	---	---	---	2.5	---
Ne----- Nebago	IIIw	75	12	65	4.0	3.6	26
NhA----- Neenah	IIw	90	14	75	4.5	4.0	30
OeA----- Oesterle	IIw	75	12	70	4.0	3.5	26
OsB----- Oshkosh	IIe	90	14	80	5.0	3.7	30
Pe. Pits							
PfA, PfB----- Plainfield	IVs	45	7	45	2.5	1.2	18
PfC----- Plainfield	VIIs	---	---	40	2.2	0.8	---
PfD----- Plainfield	VIIs	---	---	---	---	0.4	---
PlB----- Plainfield	IVs	50	8	50	3.0	1.2	18
PmA----- Plainfield	IVs	50	8	50	2.5	1.4	18
Pt----- Poy	IIw	95	15	75	4.5	3.8	30
RfA, RfB----- Richford	IIIIs	60	10	55	3.0	1.7	22
RfC----- Richford	IIIe	50	8	45	2.5	1.4	18
Rm----- Roscommon	VIw	---	---	---	---	---	---
RoA----- Rosholt	IIIs	75	12	70	4.0	2.7	31
RoB----- Rosholt	IIe	75	12	70	4.0	2.5	28
RoC----- Rosholt	IIIe	65	11	50	3.3	2.0	24
RoD----- Rosholt	IVe	55	9	45	3.3	1.6	---
RrB----- Rosholt-Rock outcrop	VIIIs	---	---	---	---	---	---
RsA----- Rousseau	IIIIs	60	10	60	3.5	2.1	---
Sb----- Seelyville	VIIw	---	---	---	---	---	---

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Corn silage	Oats	Grass-legume hay*	Kentucky bluegrass	Soybeans
		Bu	Tons	Bu	Tons	AUM**	Bu
SfB----- Shawano	IVs	55	9	55	3.0	1.5	23
SfC----- Shawano	VIIs	---	---	30	2.5	1.0	---
SfD----- Shawano	VIIs	---	---	---	1.3	0.6	---
SyA----- Symco	IIw	100	16	75	5.0	4.1	34
TlB----- Tilleda	IIe	100	15	75	5.0	4.0	26
TlC2----- Tilleda	IIIe	90	14	70	5.0	3.5	22
TuB----- Tustin	IIIe	70	11	60	4.0	3.5	24
UdC----- Udipsamments	VIIIs	---	---	---	---	---	---
Wa----- Wainola	IIIw	65	11	60	3.5	2.1	---
Wd----- Waupaca	VIw	---	---	---	---	---	---
WeA----- Wega	IIw	100	18	70	4.0	4.0	30
WhB----- Whalan	IIe	80	12	60	4.0	3.0	30
WhC2----- Whalan	IIIe	70	10	53	3.5	2.7	25
WvB----- Whalan Variant	IIIs	60	10	50	3.0	2.4	20
ZzB----- Zurich	IIe	110	18	75	5.0	4.0	37

\* Grass-legume hay yields are for brome-grass-alfalfa mixture.

\*\* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

\*\*\* Yields and the land capability classification are for areas from which boulders and stones have been removed.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>
I	---	---	---	---	---
II	196,743	113,820	78,130	4,785	---
III	92,831	67,551	6,550	18,730	---
IV	68,790	14,575	16,720	37,495	---
V	8,415	---	8,415	---	---
VI	33,240	---	18,085	15,155	---
VII	77,125	---	43,530	33,595	---
VIII	---	---	---	---	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	
Ax----- Angelica	3w	Slight	Severe	Severe	Severe	Balsam fir----- Quaking aspen----- Paper birch----- Yellow birch----- Northern white-cedar Black ash-----	54 60 --- --- --- ---	White spruce, eastern white pine, northern white-cedar.
BoB, BrB----- Borth	3c	Slight	Slight	Severe	Slight	Sugar maple----- Red maple----- White ash----- Northern red oak----- American basswood----- Eastern white pine----- Northern pin oak-----	55 --- --- --- --- --- ---	Red pine, eastern white pine, white spruce.
BxA: Borth-----	3c	Slight	Slight	Severe	Slight	Sugar maple----- Red maple----- White ash----- Northern red oak----- American basswood----- Eastern white pine----- Northern pin oak-----	55 --- --- --- --- --- ---	Red pine, eastern white pine, white spruce.
Nebago-----	2s	Slight	Slight	Moderate	Slight	Red maple----- Eastern white pine----- Northern red oak----- White ash-----	73 63 55 ---	White spruce, eastern white pine, white ash, red maple.
Meehan-----	3w	Slight	Moderate	Moderate	Moderate	Jack pine----- Northern pin oak----- Paper birch----- Eastern white pine----- Quaking aspen----- Red maple-----	55 66 67 --- 66 ---	Eastern white pine, jack pine, white spruce, red maple.
Cm: Cathro-----	3w	Slight	Severe	Severe	Severe	Northern white-cedar Balsam fir----- Tamarack----- American basswood----- Red maple----- Black spruce-----	33 40 49 40 40 15	
Markey-----	3w	Slight	Severe	Severe	Severe	Northern white-cedar Quaking aspen----- Balsam fir----- Tamarack----- Black ash----- Paper birch-----	41 45 51 --- --- ---	
EcC: Elderon-----	3x	Slight	Moderate	Slight	Slight	Sugar maple----- Yellow birch----- American basswood----- Red maple----- Northern red oak-----	57 --- --- --- ---	Red pine, eastern white pine.
Rosholt-----	2o	Slight	Slight	Slight	Slight	Sugar maple----- White ash----- Northern red oak-----	64 --- ---	Red pine, eastern white pine.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	
EcD: Elderon-----	3r	Moderate	Moderate	Slight	Slight	Sugar maple----- Yellow birch----- American basswood--- Red maple----- Northern red oak----	57 --- --- --- ---	Red pine, eastern white pine.
Rosholt-----	2r	Moderate	Moderate	Slight	Slight	Sugar maple----- White ash----- Northern red oak----	64 --- ---	Red pine, eastern white pine.
Fa----- Fordum	3w	Slight	Severe	Severe	Moderate	Silver maple----- Red maple----- White ash-----	80 --- ---	Silver maple, red maple, white ash.
HnB, HrC2----- Hortonville	1o	Slight	Slight	Slight	Slight	Sugar maple----- Northern red oak---- American basswood---	66 --- ---	Eastern white pine, red pine, white spruce.
HrD2----- Hortonville	1r	Moderate	Moderate	Slight	Slight	Sugar maple----- Northern red oak---- American basswood---	66 --- ---	Eastern white pine, red pine, white spruce.
KbB, KbC----- Kennan	1x	Slight	Moderate	Slight	Slight	Northern red oak---- Sugar maple----- American basswood--- White ash-----	76 69 69 ---	Red pine, eastern white pine, white spruce.
KbD----- Kennan	1r	Moderate	Moderate	Slight	Slight	Northern red oak---- Sugar maple----- American basswood--- White ash-----	76 69 69 ---	Red pine, eastern white pine, white spruce.
KrB, KrC----- Kranski	3s	Slight	Slight	Moderate	Slight	Jack pine----- Northern pin oak---- Eastern white pine--	60 57 ---	Red pine, eastern white pine, jack pine.
KrD----- Kranski	3s	Moderate	Moderate	Moderate	Slight	Jack pine----- Northern pin oak---- Eastern white pine--	60 57 ---	Red pine, eastern white pine, jack pine.
Mh----- Meehan	3w	Slight	Moderate	Moderate	Moderate	Jack pine----- Northern pin oak---- Paper birch----- Eastern white pine-- Quaking aspen----- Red maple-----	55 66 67 --- 66 ---	Eastern white pine, jack pine, white spruce, red maple.
MLA----- Meehan	3w	Slight	Moderate	Moderate	Moderate	Jack pine----- Northern pin oak---- Paper birch----- Red maple----- Quaking aspen-----	55 66 67 66 ---	Eastern white pine, white spruce, jack pine, red maple.
Mp----- Menasha	2w	Slight	Moderate	Severe	Moderate	White ash----- Red maple----- Silver maple----- Swamp white oak---- Northern red oak---- American elm----- Green ash----- American basswood---	65 78 79 --- --- --- --- ---	Red maple, silver maple, white ash, green ash, white spruce.
MrB----- Military	2o	Slight	Slight	Slight	Slight	Northern red oak---- White oak----- White ash----- Sugar maple-----	65 --- --- ---	Eastern white pine, red pine, white spruce.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	
Ms----- Minocqua	3w	Slight	Severe	Severe	Severe	Red maple----- White ash----- American elm----- Black ash----- American basswood----	55 --- --- --- ---	Red maple, white ash, white spruce, black spruce.
Ne----- Nebago	2s	Slight	Slight	Moderate	Slight	Red maple----- Eastern white pine-- Northern red oak---- White ash-----	69 63 55 ---	White spruce, eastern white pine, white ash, red maple.
NhA----- Neenah	2c	Slight	Moderate	Moderate	Slight	Northern red oak---- Sugar maple----- Green ash----- Red maple----- Silver maple----- White ash----- Swamp white oak----	65 --- --- --- 76 69 65	Eastern white pine, green ash, white spruce, white ash, red maple, silver maple.
OeA----- Oesterle	2w	Slight	Moderate	Slight	Moderate	Red maple----- Northern red oak---- Quaking aspen-----	66 60 65	Red maple, white ash, white spruce.
OsB----- Oshkosh	2c	Slight	Slight	Moderate	Moderate	Northern red oak---- White oak----- Red maple-----	65 --- ---	Eastern white pine, red pine, white spruce.
PfA, PfB, PfC----- Plainfield	3s	Slight	Slight	Moderate	Slight	Red pine----- Eastern white pine-- Jack pine----- Northern pin oak----	55 --- --- ---	Red pine, eastern white pine, jack pine.
PfD----- Plainfield	3r	Moderate	Severe	Moderate	Slight	Red pine----- Eastern white pine-- Jack pine----- Northern pin oak----	55 --- --- ---	Red pine, eastern white pine, jack pine.
PlB, PmA----- Plainfield	3s	Slight	Slight	Moderate	Slight	Red pine----- Eastern white pine-- Jack pine----- Northern pin oak----	55 --- --- ---	Red pine, eastern white pine, jack pine, Norway spruce.
Pt----- Poy	1w	Slight	Severe	Moderate	Moderate	Red maple----- Swamp white oak---- Northern red oak---- White ash----- Silver maple----- American elm----- Green ash----- American basswood----	86 --- --- 82 --- --- --- ---	Red maple, silver maple, white ash, green ash, white spruce.
RfA, RfB, RfC----- Richford	3s	Slight	Slight	Moderate	Slight	Northern red oak---- Red pine----- Eastern white pine--	53 51 55	Eastern white pine, red pine, jack pine, eastern redcedar.
Rm----- Roscommon	4w	Slight	Severe	Severe	Moderate	Northern white-cedar Quaking aspen----- Silver maple----- Red maple----- Balsam fir-----	29 --- 75 --- ---	
RoA, RoB, RoC----- Rosholt	2o	Slight	Slight	Slight	Slight	Sugar maple----- White ash----- Northern red oak----	64 --- ---	Red pine, eastern white pine.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	
RoD----- Rosholt	2r	Moderate	Moderate	Slight	Slight	Sugar maple----- White ash----- Northern red oak----	64 --- ---	Red pine, eastern white pine.
RrB: Rosholt-----	2o	Slight	Slight	Slight	Slight	Sugar maple----- White ash----- Northern red oak----	64 --- ---	Red pine, eastern white pine.
Rock outcrop. RsA----- Rousseau	1s	Slight	Slight	Severe	Slight	Northern red oak---- Jack pine----- Sugar maple----- Red maple----- Balsam fir----- Eastern white pine-- Red pine----- Black oak-----	71 --- --- --- --- --- --- ---	Red pine, Norway spruce, Carolina poplar, eastern white pine.
Sb----- Seelyeville	3w	Slight	Severe	Severe	Severe	Balsam fir----- White spruce----- Tamarack-----	59 54 50	White spruce.
SfB, SfC----- Shawano	2s	Slight	Slight	Moderate	Slight	Northern red oak---- Red pine----- Eastern white pine-- Jack pine----- Paper birch-----	63 --- --- --- ---	Red pine, eastern white pine, jack pine.
SfD----- Shawano	2r	Moderate	Moderate	Moderate	Slight	Northern red oak---- Red pine----- Eastern white pine-- Jack pine----- Paper birch-----	63 --- --- --- ---	Red pine, eastern white pine, jack pine.
SyA----- Symco	1o	Slight	Slight	Slight	Slight	Northern red oak---- Red maple----- White ash----- American basswood--- Sugar maple-----	79 --- --- --- ---	Red maple, eastern white pine, white ash, white spruce.
T1B, T1C2----- Tilleda	1o	Slight	Slight	Slight	Slight	Northern red oak---- Sugar maple----- Red maple----- Eastern white pine--	73 69 --- ---	Red pine, eastern white pine, white spruce.
TuB----- Tustin	3s	Slight	Slight	Moderate	Slight	Black oak----- Red pine----- Eastern white pine-- Northern red oak----	55 --- --- ---	Red pine, eastern white pine, Norway spruce.
Wa----- Wainola	1w	Slight	Moderate	Severe	Moderate	Red pine----- White ash----- Red maple----- Northern red oak----	62 --- 77 74	White spruce, Norway spruce, eastern white pine.
Wd----- Waupaca	1w	Slight	Severe	Moderate	Moderate	Silver maple----- Red maple----- White ash-----	93 --- 80	Silver maple, red maple, white ash.
WeA----- Wega	2w	Slight	Moderate	Slight	Moderate	Red maple----- Sugar maple----- Northern red oak---- American basswood--- American beech-----	65 --- --- --- ---	Eastern white pine, white spruce, silver maple, white ash.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	
WhB, WhC2----- Whalan	2o	Slight	Slight	Slight	Slight	Eastern white pine-- Northern red oak---- White oak----- Black walnut-----	58 60 60 55	Northern red oak, white oak, silver maple, eastern white pine.
WvB----- Whalan Variant	3s	Slight	Slight	Moderate	Slight	Eastern white pine-- Northern red oak---- Sugar maple-----	54 --- ---	Eastern white pine, white spruce.
ZzB----- Zurich	2o	Slight	Slight	Slight	Slight	Sugar maple----- White oak----- American basswood--- Northern red oak---- White ash-----	64 --- --- --- ---	Red pine, eastern white pine, white spruce.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ax----- Angelica	---	White spruce, silky dogwood, American cranberrybush, nannyberry viburnum, northern white-cedar.	Manchurian crabapple.	Golden willow, eastern white pine, green ash.	Carolina poplar.
BoB, BrB----- Borth	---	Northern white-cedar, silky dogwood, lilac, American cranberrybush, Amur maple, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
BxA: Borth-----	---	Northern white-cedar, silky dogwood, lilac, American cranberrybush, Amur maple, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
Nebago-----	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
Meehan-----	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac, eastern redcedar.	Norway spruce-----	Jack pine, red pine, eastern white pine.	---
Cm: Cathro. Markey.					
EcC, EcD: Elderon-----	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac, eastern redcedar.	Norway spruce-----	Jack pine, red pine, eastern white pine.	---
Rosholt-----	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac, eastern redcedar.	Norway spruce-----	Jack pine, red pine, eastern white pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Fa. Fordum					
HnB, HrC2, HrD2--- Hortonville	---	Northern white-cedar, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
KbB, KbC, KbD. Kennan					
KrB, KrC, KrD----- Kranski	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, silky dogwood, American cranberrybush, Siberian peashrub, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, Jack pine.	---
Lx. Loxley					
Mh----- Meehan	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac, eastern redcedar.	Norway spruce-----	Jack pine, red pine, eastern white pine.	---
MLA----- Meehan	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, Jack pine.	---
Mp----- Menasha	---	Northern white-cedar, lilac, American cranberrybush, nannyberry viburnum, silky dogwood, redosier dogwood, common ninebark.	White spruce-----	Silver maple, white ash, green ash, red maple.	---
MrB----- Military	---	Northern white-cedar, lilac, silky dogwood, American cranberrybush, Amur maple, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
Ms. Minocqua					

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ne----- Nebago	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
NhA----- Neenah	---	Northern white-cedar, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
OeA----- Oesterle	---	American cranberrybush, Siberian peashrub, redosier dogwood, lilac.	White spruce, Manchurian crabapple.	Eastern white pine, red pine, Norway spruce, jack pine, green ash, red maple.	---
OsB----- Oshkosh	---	Northern white-cedar, lilac, silky dogwood, American cranberrybush, Amur maple, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
Pe. Pits					
PfA, PfB, PfC, PfD----- Plainfield	Manyflower cotoneaster.	Siberian peashrub, lilac, eastern redcedar, American cranberrybush, silky dogwood, gray dogwood, Amur maple.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
PlB, PmA----- Plainfield	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
Pt----- Poy	---	Northern white-cedar, lilac, American cranberrybush, nannyberry viburnum, silky dogwood, redosier dogwood, common ninebark.	White spruce-----	Silver maple, white ash, green ash, red maple.	---
RfA, RfB, RfC----- Richford	Manyflower cotoneaster.	Eastern redcedar, lilac, Amur maple, American cranberrybush, Siberian peashrub, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Rm. Roscommon					
RoA, RoB, RoC, RoD----- Rosholt	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac, eastern redcedar.	Norway spruce-----	Jack pine, red pine, eastern white pine.	---
RrB: Rosholt-----	Manyflower cotoneaster.	Gray dogwood, silky dogwood, Siberian peashrub, American cranberrybush, Amur maple, lilac, eastern redcedar.	Norway spruce-----	Jack pine, red pine, eastern white pine.	---
Rock outcrop.					
RsA----- Rousseau	Vanhoutte spirea	Siberian crabapple, silky dogwood, Amur privet, American cranberrybush.	White spruce, eastern redcedar.	Red pine, eastern white pine, Norway spruce, red maple.	Carolina poplar.
Sb. Seelyeville					
SfB, SfC, SfD----- Shawano	Manyflower cotoneaster.	Siberian peashrub, lilac, eastern redcedar, silky dogwood, Amur maple, gray dogwood, American cranberrybush.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
SyA----- Symco	---	Northern white- cedar, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
TlB, TlC2----- Tilleda	---	Northern white- cedar, lilac, American cranberrybush, gray dogwood, silky dogwood, Amur maple.	White spruce, Norway spruce.	Eastern white pine, red pine, red maple, white ash.	---
TuB----- Tustin	Manyflower cotoneaster.	Siberian peashrub, lilac, American cranberrybush, Amur maple, eastern redcedar, silky dogwood, gray dogwood.	Norway spruce-----	Eastern white pine, red pine, jack pine.	---
UdC. Udipsamments					

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS---Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Wa----- Wainola	---	White spruce, silky dogwood, American cranberrybush, Amur privet, redosier dogwood.	Northern white-cedar, Manchurian crabapple.	Norway spruce, eastern white pine, red maple, white ash.	Carolina poplar.
Wd, Waupaca					
WeA----- Wega	---	Northern white-cedar, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
WhB, WhC2----- Whalan	---	Northern white-cedar, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
WvB----- Whalan Variant	---	Northern white-cedar, lilac, American cranberrybush, Amur maple, silky dogwood, gray dogwood.	White spruce, Norway spruce.	Eastern white pine, red pine, white ash, red maple.	---
ZzB----- Zurich	---	Siberian peashrub, lilac, redosier dogwood, gray dogwood.	Russian-olive, northern white-cedar, eastern redcedar, Amur maple.	Eastern white pine, green ash, red pine, red maple.	---

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ax----- Angelica	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
BoB, BrB----- Borth	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: slope, wetness.	Slight-----	Moderate: droughty.
BxA: Borth-----	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: wetness.	Slight-----	Moderate: droughty.
Nebago-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Meehan-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Cm: Cathro-----	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
Markey-----	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
EcC: Elderon-----	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones, large stones, droughty.
Rosholt-----	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight-----	Moderate: small stones, droughty, slope.
EcD: Elderon-----	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones, large stones, droughty.
Rosholt-----	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
Fa----- Fordum	Severe: flooding, ponding.	Severe: ponding.	Severe: small stones, ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
HnB----- Hortonville	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: large stones.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
HrC2----- Hortonville	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: large stones, slope.
HrD2----- Hortonville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
KbB----- Kennan	Slight-----	Slight-----	Severe: large stones.	Moderate: large stones.	Severe: large stones.
KbC----- Kennan	Moderate: slope.	Moderate: slope.	Severe: large stones, slope.	Moderate: large stones.	Severe: large stones.
KbD----- Kennan	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Moderate: large stones, slope.	Severe: large stones, slope.
KrB----- Kraski	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: large stones, droughty.
KrC----- Kraski	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: large stones, droughty, slope.
KrD----- Kraski	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Lx----- Loxley	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.
Mh, M1A----- Meehan	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Mp----- Menasha	Severe: ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
MrB----- Military	Slight-----	Slight-----	Moderate: slope, small stones, depth to rock.	Slight-----	Moderate: droughty, thin layer.
Ms----- Minocqua	Severe: flooding, ponding.	Severe: ponding.	Severe-----	Severe: ponding.	Severe.
Ne----- Nebago	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
NhA----- Neenah	Severe: wetness, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: too clayey.	Severe: too clayey.
OeA----- Oesterle	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness, droughty.
OsB----- Oshkosh	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.	Slight.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Pe. Pits					
PfA----- Plainfield	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
PfB----- Plainfield	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
PfC----- Plainfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope, droughty.
PfD----- Plainfield	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
PlB----- Plainfield	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
PmA----- Plainfield	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Moderate: droughty.
Pt----- Poy	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
RfA----- Richford	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Moderate: droughty.
RfB----- Richford	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
RfC----- Richford	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
Rm----- Roscommon	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
RoA, RoB----- Rosholt	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight-----	Moderate: small stones, droughty.
RoC----- Rosholt	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight-----	Moderate: small stones, droughty, slope.
RoD----- Rosholt	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
RrB: Rosholt-----	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Slight-----	Moderate: small stones, droughty.
Rock outcrop.					
RSA----- Rousseau	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
Sb----- Seelyville	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
SfB----- Shawano	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
SfC----- Shawano	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
SfD----- Shawano	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
SyA----- Symco	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
TlB----- Tilleda	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: large stones.
TlC2----- Tilleda	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: large stones, slope.
TuB----- Tustin	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight-----	Moderate: droughty.
UdC. Udipsamments					
Wa----- Wainola	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Wd----- Waupaca	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
WeA----- Wega	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
WhB----- Whalan	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Slight-----	Moderate: thin layer.
WhC2----- Whalan	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope, thin layer.
WvB----- Whalan Variant	Slight-----	Slight-----	Moderate: slope, small stones, depth to rock.	Slight-----	Moderate: thin layer.
ZzB----- Zurich	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ax----- Angelica	Good	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
BoB, BrB----- Borth	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
BxA: Borth-----	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
Nebago-----	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Meehan-----	Poor	Fair	Good	Fair	Fair	Fair	Poor	Poor	Fair	Poor.
Cm: Cathro-----	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Markey-----	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
EcC: Elderon-----	Very poor.	Poor	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Rosholt-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
EcD: Elderon-----	Very poor.	Poor	Poor	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Rosholt-----	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Fa----- Fordum	Very poor.	Very poor.	Poor	Fair	Fair	Good	Good	Very poor.	Fair	Good.
HnB, Hrc2----- Hortonville	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
HrD2----- Hortonville	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
KbB, KbC, KbD----- Kennan	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
KrB, KrC, KrD----- Kranski	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Lx----- Loxley	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Mh----- Meehan	Poor	Fair	Good	Fair	Fair	Fair	Poor	Poor	Fair	Poor.
MlA----- Meehan	Poor	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Mp----- Menasha	Good	Fair	Fair	Good	Fair	Good	Good	Fair	Good	Good.
MrB----- Military	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ms----- Minocqua	Fair	Good	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Ne----- Nebago	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
NhA----- Neenah	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
OeA----- Oesterle	Fair	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor.
OsB----- Oshkosh	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Pe. Pits										
PfA, PfB----- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
PfC, PfD----- Plainfield	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
PlB----- Plainfield	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
PmA----- Plainfield	Poor	Poor	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Pt----- Poy	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Fair.
RfA, RfB, RfC----- Richford	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Rm----- Roscommon	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
RoA, RoB----- Rosholt	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RoC----- Rosholt	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
RoD----- Rosholt	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
RrB: Rosholt-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Rock outcrop.										
RsA----- Rousseau	Poor	Poor	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Poor.
Sb----- Seelyville	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
SfB, SfC----- Shawano	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
SfD----- Shawano	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
SyA----- Symco	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
TlB----- Tilleda	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Very poor.
TlC2----- Tilleda	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
TuB----- Tustin	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
UdC. Udipsamments										
Wa----- Wainola	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor.
Wd----- Waupaca	Good	Fair	Fair	Fair	Fair	Good	Good	Good	Good	Good.
WeA----- Wega	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
WhB, WhC2----- Whalan	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WvB----- Whalan Variant	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
ZzB----- Zurich	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ax----- Angelica	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
BoB, BrB----- Borth	Severe: cutbanks cave, wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: droughty.
BxA: Borth-----	Severe: cutbanks cave, wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: droughty.
Nebago-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Meehan-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Cm: Cathro-----	Severe: excess humus, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding, excess humus.
Markey-----	Severe: cutbanks cave, excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding, excess humus.
EcC: Elderon-----	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, large stones.	Severe: small stones, large stones, droughty.
Rosholt-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: small stones, droughty, slope.
EcD: Elderon-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, large stones, droughty.
Rosholt-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Fa----- Fordum	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding.
HnB----- Hortonville	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: large stones.
HrC2----- Hortonville	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: large stones, slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
HrD2----- Hortonville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
KbB----- Kennan	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: frost action, large stones.	Severe: large stones.
KbC----- Kennan	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, frost action, large stones.	Severe: large stones.
KbD----- Kennan	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.
KrB----- Kranski	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: large stones, droughty.
KrC----- Kranski	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: large stones, droughty, slope.
KrD----- Kranski	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Lx----- Loxley	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: too acid, ponding, excess humus.
Mh, M1A----- Meehan	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Mp----- Menasha	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding, too clayey.
MrB----- Military	Moderate: depth to rock.	Slight-----	Moderate: depth to rock.	Moderate: slope.	Moderate: frost action.	Moderate: droughty, thin layer.
Ms----- Minocqua	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe.
Ne----- Nebago	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
NhA----- Neenah	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Severe: too clayey.
OeA----- Oesterle	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness, droughty.
OsB----- Oshkosh	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Pe. Pits						
PfA----- Plainfield	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
PfB----- Plainfield	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
PfC----- Plainfield	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope, droughty.
PfD----- Plainfield	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
PlB----- Plainfield	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
PmA----- Plainfield	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Slight-----	Moderate: droughty.
Pt----- Poy	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
RfA----- Richford	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
RfB----- Richford	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
RfC----- Richford	Severe: cutbanks cave.	Moderate: slope	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Rm----- Roscommon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
RoA----- Rosholt	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.	Moderate: small stones, droughty.
RoB----- Rosholt	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: small stones, droughty.
RoC----- Rosholt	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: small stones, droughty, slope.
RoD----- Rosholt	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
RrB: Rosholt-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: small stones, droughty.
Rock outcrop.						
RsA----- Rousseau	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Slight-----	Moderate: droughty.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Sb----- Seelyeville	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding, low strength.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding, excess humus.
SfB----- Shawano	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
SfC----- Shawano	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
SfD----- Shawano	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
SyA----- Symco	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: large stones, wetness.
TlB----- Tilleda	Slight-----	Moderate: shrink-swell.	Slight-----	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.	Moderate: large stones.
TlC2----- Tilleda	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.	Moderate: large stones, slope.
TuB----- Tustin	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
UdC. Udipsamments						
Wa----- Wainola	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Wd----- Waupaca	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: ponding, flooding.
WeA----- Wega	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
WhB----- Whalan	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Moderate: thin layer.
WhC2----- Whalan	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength.	Moderate: slope, thin layer.
WvB----- Whalan Variant	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Moderate: thin layer.
ZzB----- Zurich	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ax----- Angelica	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
BoB, BrB----- Borth	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
BxA: Borth-----	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Nebago-----	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
Meehan-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Cm: Cathro-----	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding.
Markey-----	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.
EcC: Elderon-----	Severe:* poor filter.	Severe: seepage, slope, large stones.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Rosholt-----	Severe:* poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
EcD: Elderon-----	Severe: poor filter, slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Rosholt-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Fa----- Fordum	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HnB----- Hortonville	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey, small stones.
HrC2----- Hortonville	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
HrD2----- Hortonville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
KbB----- Kennan	Moderate: large stones.	Severe: seepage, large stones.	Severe: seepage.	Slight-----	Poor: small stones.
KbC----- Kennan	Moderate: slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage.	Moderate: slope.	Poor: small stones.
KbD----- Kennan	Severe: slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Severe: slope.	Poor: small stones, slope.
KrB----- Kranski	Severe:* poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KrC----- Kranski	Severe:* poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
KrD----- Kranski	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: slope, seepage, too sandy.	Severe: seepage, slope.	Poor: slope, seepage, too sandy.
Lx----- Loxley	Severe: flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus, too acid.
Mh----- Meehan	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
MlA----- Meehan	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Mp----- Menasha	Severe: ponding, percs slowly.	Slight-----	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
MrB----- Military	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim.
Ms----- Minocqua	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ne----- Nebago	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack, wetness.
NhA----- Neenah	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
OeA----- Oesterle	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
OsB----- Oshkosh	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
Pe. Pits					
PfA, PfB----- Plainfield	Severe:* poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
PfC----- Plainfield	Severe:* poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
PfD----- Plainfield	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope, seepage.
PlB----- Plainfield	Severe:* poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
PmA----- Plainfield	Severe:* poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Pt----- Poy	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
RfA, RfB----- Richford	Severe:* poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
RfC----- Richford	Severe:* poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Rm----- Roscommon	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
RoA, RoB----- Rosholt	Severe:* poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
RoC----- Rosholt	Severe:* poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
RoD----- Rosholt	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
RrB: Rosholt-----	Severe:* poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Rock outcrop.					
RsA----- Rousseau	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Sb----- Seelyeville	Severe: flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
SfB----- Shawano	Severe:* poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SfC----- Shawano	Severe:* poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
SfD----- Shawano	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
SyA----- Symco	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
TlB----- Tilleda	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
TlC2----- Tilleda	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
TuB----- Tustin	Severe: percs slowly.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
UdC. Udipsamments					
Wa----- Wainola	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Wd----- Waupaca	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, too sandy.	Severe: flooding, ponding.	Poor: ponding.
WeA----- Wega	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
WhB----- Whalan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
WhC2----- Whalan	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
WvB----- Whalan Variant	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim.
ZzB----- Zurich	Moderate: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Fair: too sandy.

\* The effluent will drain satisfactorily, but there is a danger of ground water pollution.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ax----- Angelica	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, wetness.
BoB----- Borth	Fair: wetness.	Probable-----	Improbable: too sandy.	Good.
BrB----- Borth	Fair: wetness.	Probable-----	Improbable: too sandy.	Fair: too clayey.
BxA: Borth-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Fair: too clayey.
Nebago-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: thin layer.
Meehan-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Fair: too sandy, small stones.
Cm: Cathro-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Markey-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: excess humus, wetness.
EcC: Elderon-----	Fair: large stones.	Probable-----	Probable-----	Poor: small stones, area reclaim.
Rosholt-----	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
EcD: Elderon-----	Fair: large stones, slope.	Probable-----	Probable-----	Poor: small stones, area reclaim, slope.
Rosholt-----	Fair: slope.	Probable-----	Probable-----	Poor: small stones, area reclaim, slope.
Fa----- Fordum	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: small stones, wetness.
HnB, Hrc2----- Hortonville	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
HrD2----- Hortonville	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
KbB, KbC----- Kennan	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
KbD----- Kennan	Fair: large stones, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope.
KrB, KrC----- Kranski	Good-----	Probable-----	Probable-----	Poor: small stones.
KrD----- Kranski	Fair: slope.	Probable-----	Probable-----	Poor: small stones, slope.
Lx----- Loxley	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness, too acid.
Mh----- Meehan	Fair: wetness.	Probable-----	Improbable: too sandy.	Fair: too sandy, small stones.
MlA----- Meehan	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer.
Mp----- Menasha	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, wetness.
MrB----- Military	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ms----- Minocqua	Poor: wetness.	Probable-----	Probable-----	Poor: small stones, area reclaim.
Ne----- Nebago	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: thin layer.
NhA----- Neenah	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
OeA----- Oesterle	Fair: wetness.	Probable-----	Probable-----	Poor: small stones, area reclaim.
OsB----- Oshkosh	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Pe. Pits				
PfA, PfB, PfC----- Plainfield	Good-----	Probable-----	Improbable: too sandy.	Poor: thin layer.
PfD----- Plainfield	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: slope, thin layer.
PlB----- Plainfield	Good-----	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, small stones.
PmA----- Plainfield	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Pt----- Poy	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: wetness.
RfA, RfB----- Richford	Good-----	Probable-----	Probable-----	Fair: too sandy.
RfC----- Richford	Good-----	Probable-----	Probable-----	Fair: too sandy, slope.
Rm----- Roscommon	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: wetness.
RoA, RoB, RoC----- Rosholt	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
RoD----- Rosholt	Fair: slope.	Probable-----	Probable-----	Poor: small stones, area reclaim, slope.
RrB: Rosholt-----	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
Rock outcrop.				
RsA----- Rousseau	Fair: wetness.	Probable-----	Improbable: too sandy.	Fair: too sandy.
Sb----- Seelyeville	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
SfB----- Shawano	Good-----	Probable-----	Improbable: too sandy.	Fair: too sandy.
SfC----- Shawano	Good-----	Probable-----	Improbable: too sandy.	Fair: too sandy, slope.
SfD----- Shawano	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: slope.
SyA----- Symco	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
TlB----- Tilleda	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
TlC2----- Tilleda	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
TuB----- Tustin	Good-----	Probable-----	Improbable: too sandy.	Poor: thin layer.
UdC. Udipsamments				
Wa----- Wainola	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Wd----- Waupaca	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
WeA----- Wega	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
WhB----- Whalan	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
WhC2----- Whalan	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, slope.
WvB----- Whalan Variant	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too sandy, small stones.
ZzB----- Zurich	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ax----- Angelica	Slight-----	Severe: piping, ponding.	Ponding, frost action.	Ponding, rooting depth.	Ponding-----	Wetness, rooting depth.
BoB----- Borth	Severe: seepage.	Severe: seepage, piping.	Percs slowly, slope, cutbanks cave.	Droughty, percs slowly.	Too sandy, wetness, soil blowing.	Droughty, percs slowly.
BrB----- Borth	Severe: seepage.	Severe: seepage, piping.	Percs slowly, slope, cutbanks cave.	Droughty, percs slowly.	Too sandy, wetness.	Droughty, percs slowly.
BxA: Borth-----	Severe: seepage.	Severe: seepage, piping.	Percs slowly, cutbanks cave.	Droughty, percs slowly.	Too sandy, wetness.	Droughty, percs slowly.
Nebago-----	Severe: seepage.	Severe: hard to pack.	Percs slowly---	Wetness, droughty, fast intake.	Wetness, soil blowing, percs slowly.	Wetness, droughty.
Meehan-----	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, wetness.
Cm: Cathro-----	Severe: seepage.	Severe: piping, ponding.	Ponding, flooding, subsides.	Ponding, soil blowing, flooding.	Ponding, soil blowing.	Wetness.
Markey-----	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, flooding, subsides.	Ponding, soil blowing, flooding.	Ponding, too sandy, soil blowing.	Wetness.
EcC, EcD: Elderon-----	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, fast intake.	Slope, large stones, too sandy.	Large stones, slope, droughty.
Rosholt-----	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Fa----- Fordum	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, flooding, frost action.	Ponding, droughty, flooding.	Ponding, too sandy.	Wetness, droughty.
HnB----- Hortonville	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope-----	Erodes easily, soil blowing.	Erodes easily.
HrC2, HrD2----- Hortonville	Severe: slope.	Severe: piping.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.
KbB----- Kennan	Moderate: seepage, slope.	Severe: piping.	Deep to water	Large stones, droughty, slope.	Large stones---	Large stones, droughty.
KbC, KbD----- Kennan	Severe: slope.	Severe: piping.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
KrB----- Kranski	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
KrC, KrD----- Kranski	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Lx----- Loxley	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing, too acid.	Not needed-----	Not needed.
Mh----- Meehan	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, wetness.
MLA----- Meehan	Severe: seepage.	Severe: seepage.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Mp----- Menasha	Slight-----	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, droughty, percs slowly.	Ponding, percs slowly.	Wetness, droughty, rooting depth.
MrB----- Military	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, depth to rock.	Depth to rock, soil blowing.	Droughty, depth to rock.
Ms----- Minocqua	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, flooding, frost action.	Ponding, droughty.	Erodes easily, ponding, too sandy.	Wetness, erodes easily, droughty.
Ne----- Nebago	Severe: seepage.	Severe: hard to pack.	Percs slowly---	Wetness, droughty, fast intake.	Wetness, soil blowing, percs slowly.	Wetness, droughty.
NhA----- Neenah	Slight-----	Severe: hard to pack.	Percs slowly, frost action.	Wetness, droughty, percs slowly.	Wetness, percs slowly.	Wetness, droughty, rooting depth.
OeA----- Oesterle	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness, droughty, soil blowing.	Wetness, too sandy, soil blowing.	Wetness, droughty.
OsB----- Oshkosh	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, rooting depth.	Erodes easily, percs slowly.	Erodes easily, rooting depth.
Pe. Pits						
PfA, PfB----- Plainfield	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
PfC, PfD----- Plainfield	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Droughty, slope.
PlB----- Plainfield	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
PmA----- Plainfield	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Pt----- Poy	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, too sandy.	Wetness, rooting depth.
RfA, RfB----- Richford	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
RfC----- Richford	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Rm----- Roscommon	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
RoA----- Rosholt	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
RoB----- Rosholt	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
RoC, RoD----- Rosholt	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
RrB: Rosholt-----	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
Rock outcrop.						
RsA----- Rousseau	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
Sb----- Seelyeville	Severe: seepage.	Severe: excess humus, ponding.	Ponding, flooding, subsides.	Ponding, soil blowing, flooding.	Ponding, soil blowing.	Wetness.
SfB----- Shawano	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
SfC, SfD----- Shawano	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
SyA----- Symco	Slight-----	Severe: wetness.	Frost action---	Wetness, rooting depth.	Erodes easily, wetness.	Wetness, erodes easily, rooting depth.
TlB----- Tilleda	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope-----	Favorable-----	Favorable.
TlC2----- Tilleda	Severe: slope.	Moderate: piping.	Deep to water	Slope-----	Slope-----	Slope.
TuB----- Tustin	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty, rooting depth, percs slowly.
UdC. Udipsamments						

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Wa----- Wainola	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Wd----- Waupaca	Slight-----	Severe: piping, ponding.	Ponding, flooding, frost action.	Ponding, flooding.	Erodes easily, ponding.	Wetness, erodes easily.
WeA----- Wega	Slight-----	Severe: piping.	Frost action--	Wetness-----	Erodes easily, wetness.	Wetness, erodes easily.
WhB----- Whalan	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Peres slowly, depth to rock, slope.	Depth to rock	Depth to rock, peres slowly.
WhC2----- Whalan	Severe: slope.	Severe: thin layer.	Deep to water	Peres slowly, depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock, peres slowly.
WvB----- Whalan Variant	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Fast intake, soil blowing, depth to rock.	Depth to rock, erodes easily, soil blowing.	Erodes easily, depth to rock.
ZzB----- Zurich	Severe: seepage.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol &lt; means less than; &gt; means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
Ax----- Angelica	0-8	Silt loam-----	ML	A-4, A-6	0-10	90-100	85-100	80-100	55-90	25-40	2-13
	8-11	Loam, sandy loam, clay loam.	SM, ML, SC, CL	A-4, A-6	0-10	90-100	85-100	50-90	36-90	12-40	2-20
	11-25	Sandy clay loam, loam, clay loam.	SC, CL, SM-SC, CL-ML	A-2-4, A-6, A-4, A-2-6	0-10	90-100	85-100	70-100	25-90	15-40	5-23
	25-60	Loam, sandy loam, gravelly loam.	ML, SM, CL, SC	A-2-4, A-4, A-6, A-2-6	0-15	85-100	80-100	50-100	30-90	20-40	NP-16
BoB----- Borth	0-9	Sandy loam-----	SM-SC, SC	A-2, A-4	0	100	100	60-70	30-40	20-30	4-10
	9-24	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	55-90	30-60
	24-60	Sand, loamy sand, very fine sand.	SM, SP-SM	A-2, A-3	0	80-100	75-100	50-100	5-35	<21	NP-4
BrB----- Borth	0-9	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-60	15-35
	9-24	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	55-90	30-60
	24-60	Sand, loamy sand, very fine sand.	SM, SP-SM	A-2, A-3	0	80-100	75-100	50-100	5-35	<21	NP-4
BxA: Borth-----	0-9	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-60	15-35
	9-24	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	55-90	30-60
	24-60	Sand, loamy sand, very fine sand.	SM, SP-SM	A-2, A-3	0	80-100	75-100	50-100	5-35	<21	NP-4
Nebago-----	0-13	Loamy sand-----	SM, SP-SM	A-2, A-3	0	100	90-100	60-90	5-30	---	NP
	13-31	Sand, loamy sand	SP, SP-SM	A-2, A-3	0	100	100	50-90	1-12	---	NP
	31-54	Silty clay, clay	CL, CH	A-7	0	100	100	85-100	70-100	40-90	20-60
	54-60	Sand-----	SP, SP-SM	A-2, A-3, A-1	0	100	100	30-70	1-12	---	NP
Meehan-----	0-9	Loamy sand-----	SM	A-2, A-1	0	90-100	75-100	40-90	15-30	---	NP
	9-26	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-1, A-2, A-3	0	90-100	75-100	40-90	3-30	---	NP
	26-60	Sand, coarse sand	SP, SP-SM	A-1, A-3, A-2	0	90-100	75-100	40-90	0-5	---	NP
Cm: Cathro-----	0-40	Sapric material	PT	A-8	0	---	---	---	---	---	---
	40-60	Sandy loam, loam, silt loam.	SM, ML, SC, CL	A-4	0-5	80-100	65-100	60-100	35-90	<25	3-10
Markey-----	0-21	Sapric material	PT	A-8	---	---	---	---	---	---	---
	21-60	Sand, loamy sand, fine sand.	SP, SM, SP-SM	A-2, A-3	0	100	85-100	60-75	0-20	---	NP
EcC, EcD: Elderon-----	0-6	Stony loamy coarse sand.	SM, SP-SM, GM, GP-GM	A-1, A-2, A-3	25-50	30-95	30-95	15-75	5-30	---	NP
	6-19	Very gravelly coarse sandy loam, very gravelly loamy coarse sand.	SM, SP-SM, GM, GP-GM	A-1	25-50	30-70	30-70	15-50	5-25	<25	NP-4
	19-49	Very gravelly loamy coarse sand, gravelly coarse sand, very cobbly sand.	SM, SP, GM, GP	A-1	25-50	30-70	30-70	10-50	1-25	---	NP
	49-60	Very gravelly coarse sand, cobbly coarse sand, gravelly sand.	SM, SP, GM, GP	A-1	25-50	30-70	25-70	10-50	1-20	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Rosholt-----	0-7	Sandy loam-----	SM, SM-SC	A-2, A-1, A-4	0-3	75-100	70-100	45-70	20-40	<25	NP-4
	7-18	Loam, sandy loam, silt loam.	SM, ML, SM-SC, CL-ML	A-2, A-4, A-1	0-3	75-100	70-100	35-95	12-90	<25	NP-6
	18-30	Sandy loam, loam, silt loam.	SC, SM, CL, ML	A-2, A-4, A-1, A-6	0-5	75-100	70-100	45-95	20-90	<30	NP-12
	30-35	Gravelly loamy sand, loamy sand, sandy loam.	SM, GM, SP-SM, GP-GM	A-1, A-2, A-4	0-10	50-100	45-100	25-75	10-40	<25	NP-4
	35-60	Stratified sand to gravel.	GP, SP, SP-SM, GP-GM	A-1, A-2, A-3	0-25	20-100	20-100	10-65	0-10	---	NP
Fa----- Fordum	0-9	Loam-----	ML, CL, SM, SC	A-4, A-6	0-10	75-100	70-100	60-100	40-95	20-35	3-15
	9-38	Loam, fine sandy loam, sandy loam.	SM, SC, ML, CL	A-2, A-4	0-10	75-100	70-100	40-85	20-75	<30	3-10
	38-60	Sand, loamy sand, gravelly sand.	SP, SP-SM, SM	A-3, A-2, A-1	0-10	30-100	25-100	10-80	2-35	---	NP
HnB----- Hortonville	0-9	Fine sandy loam	SM, ML, SC, CL	A-4, A-2	0-7	80-100	75-100	55-90	25-60	26	1-8
	9-28	Clay loam, loam, sandy clay loam	CL, CH, SC	A-7, A-6	0-7	80-100	75-100	65-100	45-95	35-60	15-40
	28-60	Fine sandy loam, loam, clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6, A-2	0-7	75-100	75-100	50-100	30-80	20-40	4-20
HrC2, HrD2----- Hortonville	0-9	Loam-----	CL, CL-ML, SC, SM-SC	A-4	0-7	80-100	75-100	65-100	45-100	20-30	4-9
	9-28	Clay loam, loam, sandy clay loam.	CL, CH, SC	A-7, A-6	0-7	80-100	75-100	65-100	45-95	35-60	15-40
	28-60	Fine sandy loam, loam, clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6, A-2	0-7	75-100	75-100	50-100	30-80	20-40	4-20
KbB, KbC, KbD----- Kennan	0-21	Bouldery sandy loam.	SM-SC, SM, ML, CL-ML	A-2, A-4, A-1	25-50	75-100	75-100	45-85	20-55	<23	2-6
	21-60	Loam, sandy loam, silt loam.	SC, ML, CL, SM	A-4, A-1, A-2	0-25	75-100	70-100	40-100	20-90	<28	3-10
KrB, KrC, KrD----- Kranski	0-22	Loamy sand-----	SM	A-1, A-2	0-7	75-100	75-100	45-75	13-20	---	NP
	22-26	Sandy loam, loamy sand.	SM, SM-SC	A-1, A-2, A-4	0-7	75-100	75-100	45-70	20-40	<25	2-7
	26-34	Loamy sand-----	SM, SP-SM	A-1, A-2	0-7	75-100	75-100	45-75	12-20	---	NP
	34-60	Loamy sand, sand, gravelly loamy sand.	SP, SP-SM, SM	A-1, A-2, A-3	0-7	60-90	60-90	30-70	2-20	---	NP
Lx----- Loxley	0-2	Fibric material	PT	A-8	0	---	---	---	---	---	---
	2-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
Mh----- Meehan	0-9	Loamy sand-----	SM	A-2, A-1	0	90-100	75-100	40-90	15-30	---	NP
	9-26	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-1, A-2, A-3	0	90-100	75-100	40-90	3-30	---	NP
	26-60	Sand, coarse sand	SP, SP-SM	A-1, A-3, A-2	0	90-100	75-100	40-90	0-5	---	NP
MLA----- Meehan	0-9	Loamy sand-----	SM	A-2	0	95-100	75-95	50-75	15-30	---	NP
	9-43	Sand-----	SM, SP-SM	A-2, A-3	0	95-100	75-85	50-70	5-15	---	NP
	43-60	Loam-----	CL	A-4, A-6	0-5	85-100	80-95	60-90	50-75	26-39	8-18
Mp----- Menasha	0-12	Silty clay-----	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-70	15-40
	12-29	Clay-----	CH	A-7	0	100	100	95-100	90-100	65-90	35-60
	29-60	Clay-----	CH	A-7	0	100	100	95-100	90-100	61-90	35-60

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
MrB----- Military	0-10	Loamy sand-----	SM, SP-SM	A-2, A-1	0-5	80-100	75-100	40-75	12-30	---	NP
	10-27	Sandy loam, sandy clay loam, loam.	SC, CL	A-4, A-6, A-2	0-5	80-100	75-100	50-100	25-80	25-40	8-18
	27	Unweathered bedrock, weathered bedrock.	---	---	---	---	---	---	---	---	---
Ms----- Minocqua	0-7	Mucky fine sandy loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0-8	80-100	75-100	45-85	25-55	<20	2-7
	7-37	Silt loam, loam, sandy loam.	SC, SM-SC, CL, CL-ML	A-2, A-4	0-8	80-100	75-100	45-100	25-90	20-30	4-10
	37-60	Gravelly coarse sand, sand, gravelly sand.	SP, SP-SM, GP, GP-GM	A-1, A-2, A-3	0-8	35-100	30-100	5-75	0-30	---	NP
Ne----- Nebago	0-13	Loamy sand-----	SM, SP-SM	A-2, A-3	0	100	90-100	60-90	5-30	---	NP
	13-31	Sand, loamy sand	SP, SP-SM	A-2, A-3	0	100	100	50-90	1-12	---	NP
	31-54	Silty clay, clay	CL, CH	A-7	0	100	100	85-100	70-100	40-90	20-60
	54-60	Sand-----	SP, SP-SM	A-2, A-3, A-1	0	100	100	30-70	1-12	---	NP
NhA----- Neenah	0-8	Silty clay-----	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-70	15-40
	8-16	Clay-----	CH	A-7	0	100	100	95-100	90-100	57-90	34-60
	16-60	Clay-----	CH	A-7	0	100	100	95-100	90-100	65-90	35-60
OeA----- Oesterle	0-12	Sandy loam-----	SM, SM-SC	A-2, A-4, A-1	0-7	95-100	75-95	45-70	20-40	<25	2-7
	12-24	Sandy loam, loam	CL-ML, CL, SM-SC, SC	A-2, A-4, A-1	0-7	90-100	70-95	40-90	20-70	20-30	4-10
	24-28	Sandy loam, loamy sand, gravelly loamy sand.	SM, SP-SM, SM-SC	A-2, A-1	0-7	90-100	50-90	25-75	10-35	<20	NP-6
	28-60	Gravelly sand, sand, loamy sand.	SW, SP-SM, SP	A-1, A-3, A-2	0-7	60-90	40-85	20-60	0-10	---	NP
OsB----- Oshkosh	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	13-22
	10-28	Clay-----	CH	A-7	0	100	100	90-100	85-100	60-80	30-45
	28-60	Silty clay, clay	CH	A-7	0	100	100	90-100	85-100	55-80	30-45
Pe. Pits											
PfA, PfB, PfC, PfD----- Plainfield	0-8	Loamy sand-----	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	8-25	Sand-----	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-70	1-15	---	NP
	25-60	Sand, fine sand	SP, SM, SP-SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP
PlB----- Plainfield	0-8	Loamy sand-----	SM, SP-SM	A-2, A-4, A-1	0	75-100	75-95	40-90	12-40	---	NP
	8-50	Sand-----	SP, SP-SM, SM	A-2, A-3, A-1	0	75-100	75-100	40-70	1-15	---	NP
	50-60	Loam, sandy loam, silt loam.	CL, SC, ML, SM	A-4, A-6	0-5	85-100	80-95	60-90	35-80	25-40	7-16
PmA----- Plainfield	0-9	Loamy sand-----	SM, SP-SM	A-2-4, A-4, A-1	0	75-100	75-100	40-90	12-40	---	NP
	9-26	Sand-----	SP, SP-SM, SM	A-3, A-1-B, A-2-4	0	75-100	75-100	40-70	1-15	---	NP
	26-60	Sand, fine sand	SP, SP-SM, SM	A-3, A-1, A-2	0	75-100	75-100	40-90	1-15	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit  Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>						
Pt----- Poy	0-10	Clay loam-----	CL	A-6, A-7	0	100	100	90-100	70-80	35-50	15-25
	10-27	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	70-100	40-90	20-60
	27-60	Sand, fine sand, loamy fine sand.	SM, SP-SM, ML, SP	A-2, A-3, A-4	0	80-100	75-100	50-100	4-60	---	NP
RfA, RfB, RfC---- Richford	0-7	Loamy sand-----	SM	A-2, A-4, A-1	0-5	75-100	75-100	40-90	12-40	---	NP
	7-21	Loamy sand, sand	SM, SP-SM, SP	A-1, A-2, A-3	0-5	75-100	75-100	40-75	3-30	---	NP
	21-27	Sandy loam, fine sandy loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0-5	75-100	75-100	50-85	25-55	<25	2-6
	27-38	Loamy sand-----	SM	A-1, A-2	0-5	75-100	75-100	40-75	12-30	---	NP
	38-60	Sand, gravelly sand.	SP, SP-SM, SM	A-1, A-2, A-3	0-10	55-100	55-100	30-70	1-15	---	NP
Rm----- Roscommon	0-9	Loamy sand-----	SM, SP-SM	A-2, A-3	0	100	95-100	50-70	5-25	---	NP
	9-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	95-100	85-100	40-70	0-15	---	NP
RoA, RoB, RoC, RoD----- Rosholt	0-7	Sandy loam-----	SM, SM-SC	A-2, A-1, A-4	0-3	75-100	70-100	45-70	20-40	<25	NP-4
	7-18	Loam, sandy loam, silt loam.	SM, ML, SM-SC, CL-ML	A-2, A-4, A-1	0-3	75-100	70-100	35-95	12-90	<25	NP-6
	18-30	Sandy loam, loam, silt loam.	SC, SM, CL, ML	A-2, A-4, A-1, A-6	0-5	75-100	70-100	45-95	20-90	<30	NP-12
	30-35	Gravelly loamy sand, loamy sand, sandy loam.	SM, GM, SP-SM, GP-GM	A-1, A-2, A-4	0-10	50-100	45-100	25-75	10-40	<25	NP-4
	35-60	Stratified sand to gravel.	GP, SP, SP-SM, GP-GM	A-1, A-2, A-3	0-25	20-100	20-100	10-65	0-10	---	NP
RrB: Rosholt-----	0-7	Sandy loam-----	SM, SM-SC	A-2, A-1, A-4	0-3	75-100	70-100	45-70	20-40	<25	NP-4
	7-18	Loam, sandy loam, silt loam.	SM, ML, SM-SC, CL-ML	A-2, A-4, A-1	0-3	75-100	70-100	35-95	12-90	<25	NP-6
	18-30	Sandy loam, loam, silt loam.	SC, SM, CL, ML	A-2, A-4, A-1, A-6	0-5	75-100	70-100	45-95	20-90	<30	NP-12
	30-35	Gravelly loamy sand, loamy sand, sandy loam.	SM, GM, SP-SM, GP-GM	A-1, A-2, A-4	0-10	50-100	45-100	25-75	10-40	<25	NP-4
	35-60	Stratified sand to gravel.	GP, SP, SP-SM, GP-GM	A-1, A-2, A-3	0-25	20-100	20-100	10-65	0-10	---	NP
Rock outcrop.											
RsA----- Rousseau	0-8	Loamy fine sand	SM	A-2-4, A-4	0	100	100	75-95	25-45	---	NP
	8-30	Fine sand-----	SP-SM, SM	A-3, A-2-4	0	100	100	90-100	5-25	---	NP
	30-60	Fine sand, sand	SP, SP-SM	A-3	0	100	100	85-100	0-10	---	NP
Sb----- Seelyeville	0-60	Sapric material	PT	A-8	0	---	---	---	---	---	---
SfB, SfC, SfD---- Shawano	0-7	Loamy fine sand	SM	A-2, A-4	0	95-100	95-100	75-100	30-40	---	NP
	7-29	Fine sand-----	SM	A-2	0	95-100	95-100	65-100	20-35	---	NP
	29-60	Fine sand, very fine sand, sand.	SP, SM, SP-SM, ML	A-2, A-3, A-1, A-4	0	95-100	95-100	45-100	2-55	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
SyA----- Symco	0-8	Loam-----	ML, CL-ML, CL	A-4, A-6	0-15	85-100	85-100	85-100	60-90	20-35	3-15
	8-26	Clay loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0-15	85-100	85-100	75-100	50-85	26-46	9-27
	26-60	Clay loam, loam, silty clay loam.	CL	A-4, A-6	0-15	85-100	85-100	75-100	50-85	20-40	7-18
TlB, TlC2----- Tilleda	0-10	Loam-----	CL, ML, CL-ML	A-4	0-8	95-100	85-100	75-100	50-90	20-30	2-10
	10-44	Loam, sandy clay loam, clay loam.	CL, SC	A-4, A-2, A-6, A-7	0-8	95-100	85-100	70-100	30-70	25-47	9-27
	44-60	Loam, clay loam, gravelly sandy loam.	CL, SC	A-4, A-6, A-7	0-8	95-100	60-100	50-95	40-80	25-46	7-27
TuB----- Tustin	0-9	Loamy sand-----	SM, SP-SM	A-2, A-3	0	100	100	60-90	5-30	---	NP
	9-28	Sand, loamy sand	SP, SP-SM, SM	A-2, A-3	0	100	100	50-90	1-25	---	NP
	28-30	Sandy clay loam, sandy loam, loam.	SC, CL	A-2, A-4, A-6	0	100	100	60-95	30-75	25-35	7-15
	30-42	Silty clay loam, clay, silty clay.	CL, CH	A-6, A-7	0	100	100	90-100	75-95	35-60	15-40
	42-60	Sand-----	SP-SM, SP	A-1, A-2, A-3	0	100	100	30-70	1-12	---	NP
UdC. Udipsamments											
Wa----- Wainola	0-9	Loamy fine sand	SM	A-2-4	0	100	95-100	55-80	20-35	---	NP
	9-25	Fine sand, loamy fine sand.	SM	A-2-4	0	100	95-100	50-80	15-35	---	NP
	25-60	Fine sand, loamy fine sand.	SM	A-2-4	0	100	95-100	50-80	15-35	---	NP
Wd----- Waupaca	0-9	Silt loam-----	ML, CL-ML	A-4	0	100	100	100	95-100	<25	NP-7
	9-60	Stratified silt to very fine sand.	ML, CL-ML, CL	A-4	0	100	100	95-100	90-100	<28	NP-9
WeA----- Wega	0-9	Silt loam-----	ML, CL-ML	A-4	0	100	100	100	95-100	<25	NP-7
	9-60	Stratified silt to silt loam.	ML, CL-ML	A-4	0	100	100	95-100	90-100	<25	NP-7
WhB, WhC2----- Whalan	0-7	Loam-----	ML	A-4	0	100	95-100	85-95	60-90	30-40	5-10
	7-35	Clay loam, loam	CL	A-6	0	95-100	95-100	80-95	70-90	30-40	10-15
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
WvB----- Whalan Variant	0-11	Loamy fine sand	SM	A-2, A-4	0	90-100	85-100	65-85	25-45	---	NP
	11-15	Loamy sand, loamy fine sand.	SM, SP-SM	A-1, A-2, A-4	0	90-100	85-100	40-85	10-45	---	NP
	15-24	Silty clay loam, clay loam.	CL	A-6, A-7	0-5	80-100	75-100	70-100	60-95	35-45	15-25
	24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
ZzB----- Zurich	0-7	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	80-95	25-40	5-20
	7-20	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	95-100	90-100	60-90	30-45	10-25
	20-60	Stratified very fine sand to silt loam.	ML, CL, SM, SC	A-2, A-4, A-6	0	90-100	80-100	70-100	30-95	20-40	NP-20

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm <sup>3</sup>	In/hr	In/in	pH					Pct
Ax----- Angelica	0-8 8-11 11-25 25-60	10-20 18-35 18-35 5-20	1.15-1.60 1.50-1.80 1.50-1.80 1.45-1.95	0.6-2.0 0.6-2.0 0.2-0.6 0.2-0.6	0.18-0.22 0.10-0.18 0.10-0.20 0.10-0.20	6.1-7.3 6.1-7.3 6.1-7.3 7.4-8.4	Low----- Low----- Moderate----- Low-----	0.32 0.32 0.32 0.32	5	5	2-4
BoB----- Borth	0-9 9-24 24-60	10-20 50-85 1-10	1.40-1.70 1.35-1.50 1.55-1.70	0.6-2.0 0.06-0.6 6.0-20	0.13-0.15 0.09-0.13 0.04-0.10	6.1-7.8 5.6-8.4 6.6-8.4	Low----- High----- Low-----	0.24 0.32 0.15	3	3	2-4
BrB----- Borth	0-9 9-24 24-60	30-50 50-85 1-10	1.35-1.60 1.35-1.50 1.55-1.70	0.2-0.6 0.06-0.6 6.0-20	0.12-0.23 0.09-0.13 0.04-0.10	6.1-7.8 5.6-8.4 6.6-8.4	High----- High----- Low-----	0.32 0.32 0.15	3	4	2-4
BxA: Borth-----	0-9 9-24 24-60	30-50 50-85 1-10	1.35-1.60 1.35-1.50 1.55-1.70	0.2-0.6 0.06-0.6 6.0-20	0.12-0.23 0.09-0.13 0.04-0.10	6.1-7.8 5.6-8.4 6.6-8.4	High----- High----- Low-----	0.32 0.32 0.15	3	4	2-4
Nebago-----	0-13 13-31 31-54 54-60	3-12 1-4 35-85 1-4	1.40-1.70 1.40-1.70 1.80-1.90 1.50-1.65	6.0-20 6.0-20 0.06-0.6 6.0-20	0.07-0.13 0.06-0.08 0.09-0.20 0.05-0.07	5.6-7.3 5.6-7.3 5.6-7.3 6.6-8.4	Low----- Low----- High----- Low-----	0.17 0.17 0.28 0.15	4	2	1-2
Meehan-----	0-9 9-26 26-60	4-10 4-9 1-4	1.35-1.65 1.35-1.65 1.50-1.65	6.0-20 6.0-20 6.0-20	0.10-0.12 0.06-0.11 0.02-0.07	5.1-7.3 5.1-7.3 5.1-7.8	Low----- Low----- Low-----	0.17 0.17 0.17	5	2	1-2
Cm: Cathro-----	0-40 40-60	--- 10-25	0.28-0.45 1.50-1.70	2.0-6.0 0.2-2.0	0.45-0.55 0.11-0.22	5.6-7.8 6.1-8.4	----- Low-----	----- -----	2	8	60-85
Markey-----	0-21 21-60	--- 0-10	0.15-0.45 1.40-1.65	2.0-6.0 6.0-20	0.35-0.45 0.03-0.08	5.6-7.8 5.6-8.4	----- Low-----	----- -----	2	8	55-85
EcC, EcD: Elderon-----	0-6 6-19 19-49 49-60	2-8 2-10 2-8 1-6	1.40-1.70 1.60-1.70 1.60-1.70 1.55-1.70	2.0-6.0 6.0-20 6.0-20 >20	0.03-0.12 0.03-0.12 0.01-0.05 0.01-0.05	5.1-7.3 5.1-7.3 5.1-7.3 6.6-7.8	Low----- Low----- Low----- Low-----	0.10 0.10 0.10 0.10	3	8	.5-1
Rosholt-----	0-7 7-18 18-30 30-35 35-60	4-10 3-12 6-18 4-16 0-5	1.50-1.60 1.70-1.80 1.65-1.75 1.55-1.65 1.55-2.20	0.6-6.0 0.6-6.0 0.6-6.0 0.6-6.0 >6.0	0.10-0.18 0.10-0.22 0.09-0.22 0.04-0.16 0.02-0.04	4.5-7.3 4.5-7.3 4.5-7.3 4.5-7.3 5.1-6.5	Low----- Low----- Low----- Low----- Low-----	0.24 0.24 0.24 0.10 0.10	4	3	1-2
Pa----- Fordum	0-9 9-38 38-60	10-23 8-18 2-5	1.35-1.45 1.40-1.50 1.55-1.70	0.6-2.0 0.6-2.0 >6.0	0.14-0.28 0.08-0.19 0.02-0.09	4.5-8.4 4.5-8.4 4.5-8.4	Low----- Low----- Low-----	0.24 0.32 0.15	4	8	4-12
HnB----- Hortonville	0-9 9-28 28-60	5-15 23-35 10-32	1.20-1.70 1.50-1.70 1.60-1.75	0.6-2.0 0.6-2.0 0.6-2.0	0.13-0.18 0.12-0.19 0.11-0.19	5.6-7.8 5.6-7.8 7.4-8.4	Low----- Moderate----- Moderate-----	0.24 0.37 0.37	5	3	2-3
HrC2, HrD2----- Hortonville	0-9 9-28 28-60	10-18 23-35 10-32	1.20-1.65 1.50-1.70 1.60-1.75	0.6-2.0 0.6-2.0 0.6-2.0	0.16-0.24 0.12-0.19 0.11-0.19	2.6-7.8 5.6-7.8 7.4-8.4	Low----- Moderate----- Moderate-----	0.37 0.37 0.37	5	5	1-2
KbB, KbC, KbD----- Kennan	0-21 21-60	5-12 5-18	1.20-1.60 1.55-1.70	0.6-2.0 0.6-2.0	0.06-0.13 0.08-0.22	4.5-7.3 4.5-7.3	Low----- Low-----	0.17 0.24	5	8	2-4

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm <sup>3</sup>	In/hr	In/in	pH					Pct
KrB, KrC, KrD----- Kranski	0-22	2-6	1.35-1.65	2.0-6.0	0.08-0.12	5.1-6.5	Low-----	0.17	5	2	.5-1
	22-26	6-15	1.45-1.70	2.0-6.0	0.10-0.15	5.1-6.5	Low-----	0.17			
	26-34	4-8	1.55-1.70	6.0-20	0.07-0.11	5.1-6.5	Low-----	0.17			
	34-60	2-6	1.55-1.70	6.0-20	0.03-0.10	5.1-7.8	Low-----	0.17			
Lx----- Loxley	0-2	---	0.30-0.40	2.0-6.0	0.45-0.55	<4.5	-----	---	2	8	70-90
	2-60	---	0.10-0.35	2.0-6.0	0.35-0.45	<4.5	-----	---			
Mh----- Meehan	0-9	4-10	1.35-1.65	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	5	2	1-2
	9-26	4-9	1.35-1.65	6.0-20	0.06-0.11	5.1-7.3	Low-----	0.17			
	26-60	1-4	1.50-1.65	6.0-20	0.02-0.07	5.1-7.8	Low-----	0.17			
MlA----- Meehan	0-9	4-10	1.10-1.35	6.0-20	0.08-0.12	6.1-7.3	Low-----	0.17	5	2	1-2
	9-43	0-5	1.45-1.80	6.0-20	0.05-0.07	5.6-7.3	Low-----	0.17			
	43-60	15-30	1.60-1.70	0.6-2.0	0.14-0.18	7.4-7.8	Moderate----	0.37			
Mp----- Menasha	0-12	27-60	1.65-1.72	0.2-0.6	0.11-0.23	6.1-7.8	Moderate----	0.32	3	4	4-7
	12-29	60-85	1.80-1.95	<0.2	0.09-0.11	6.1-8.4	High-----	0.32			
	29-60	60-85	1.80-1.95	<0.2	0.08-0.11	7.4-8.4	High-----	0.32			
MrB----- Military	0-10	3-7	1.25-1.40	2.0-6.0	0.09-0.12	5.1-7.3	Low-----	0.17	4	2	.5-1
	10-27	18-30	1.55-1.65	0.6-2.0	0.10-0.19	5.1-6.5	Low-----	0.24			
	27	---	---	---	---	---	---	---			
Ms----- Minocqua	0-7	5-10	1.20-1.65	0.6-2.0	0.12-0.15	4.5-7.8	Low-----	0.24	4	3	4-8
	7-37	10-18	1.35-1.45	0.6-2.0	0.11-0.19	4.5-7.8	Low-----	0.37			
	37-60	0-3	1.55-1.80	>6.0	0.02-0.04	4.5-7.8	Low-----	0.10			
Ne----- Nebago	0-13	3-12	1.40-1.70	6.0-20	0.07-0.13	5.6-7.3	Low-----	0.17	4	2	1-2
	13-31	1-4	1.40-1.70	6.0-20	0.06-0.08	5.6-7.3	Low-----	0.17			
	31-54	35-85	1.80-1.90	0.06-0.6	0.09-0.20	5.6-7.3	High-----	0.28			
	54-60	1-4	1.50-1.65	6.0-20	0.05-0.07	6.6-8.4	Low-----	0.15			
NhA----- Neenah	0-8	30-60	1.65-1.72	0.2-0.6	0.11-0.23	6.1-7.8	Moderate----	0.28	3	4	2-3
	8-16	60-85	1.83-1.95	<0.2	0.09-0.11	5.6-8.4	High-----	0.28			
	16-60	60-85	1.80-1.95	<0.2	0.08-0.11	7.4-8.4	High-----	0.28			
OeA----- Oesterle	0-12	8-15	1.40-1.70	0.6-2.0	0.10-0.15	4.5-6.5	Low-----	0.24	4	3	2-3
	12-24	10-18	1.55-1.65	0.6-2.0	0.09-0.19	4.5-6.5	Low-----	0.24			
	24-28	6-12	1.55-1.70	0.6-6.0	0.06-0.13	4.5-6.5	Low-----	0.24			
	28-60	1-6	1.55-1.70	>6.0	0.02-0.04	5.1-6.5	Low-----	0.10			
OsB----- Oshkosh	0-10	27-40	1.35-1.60	0.2-2.0	0.21-0.23	6.1-7.8	Moderate----	0.37	3	6	2-3
	10-28	60-75	1.65-1.80	<0.2	0.09-0.13	5.1-8.4	Moderate----	0.28			
	28-60	50-75	1.65-1.80	<0.2	0.08-0.12	7.4-8.4	Moderate----	0.28			
Pe. Pits											
PfA, PfB, PfC, PfD----- Plainfield	0-8	3-7	1.50-1.65	2.0-6.0	0.09-0.12	4.5-7.3	Low-----	0.17	5	2	.5-1
	8-25	0-4	1.50-1.65	6.0-20	0.04-0.07	4.5-6.5	Low-----	0.17			
	25-60	0-4	1.50-1.70	6.0-20	0.04-0.07	4.5-6.5	Low-----	0.17			
PlB----- Plainfield	0-8	3-7	1.50-1.65	2.0-6.0	0.08-0.11	4.5-7.3	Low-----	0.17	5	2	.5-1
	8-50	<4	1.50-1.70	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.17			
	50-60	15-27	1.60-1.70	0.6-2.0	0.13-0.18	5.1-8.4	Low-----	0.32			
PmA----- Plainfield	0-9	3-7	1.50-1.65	2.0-6.0	0.10-0.12	4.5-7.3	Low-----	0.17	5	2	.5-1
	9-26	0-4	1.50-1.70	6.0-20	0.04-0.08	4.5-6.0	Low-----	0.17			
	26-60	0-4	1.50-1.70	6.0-20	0.04-0.07	4.5-6.5	Low-----	0.17			
Pt----- Poy	0-10	27-40	1.35-1.55	0.2-0.6	0.17-0.19	6.1-7.8	Moderate----	0.28	3	6	4-8
	10-27	35-85	1.55-1.65	<0.2	0.09-0.13	6.1-8.4	High-----	0.28			
	27-60	2-9	1.55-1.80	6.0-20	0.04-0.10	6.6-8.4	Low-----	0.15			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm <sup>3</sup>	In/hr	In/in	pH					Pct
RfA, RfB, RfC----- Richford	0-7 7-21 21-27 27-38 38-60	4-10 2-12 6-12 2-12 1-5	1.35-1.65 1.50-1.70 1.55-1.70 1.55-1.70 1.65-1.80	2.0-6.0 2.0-20 2.0-6.0 6.0-20 6.0-20	0.09-0.13 0.05-0.11 0.10-0.17 0.07-0.10 0.03-0.07	5.6-7.3 5.6-7.3 5.1-6.5 5.1-6.5 6.1-7.3	Low----- Low----- Low----- Low----- Low-----	0.17 0.17 0.17 0.17 0.17	5	2	.5-1
Rm----- Roscommon	0-9 9-60	0-12 0-10	0.90-1.60 1.45-1.75	6.0-20 6.0-20	0.07-0.20 0.05-0.07	5.6-7.8 5.6-8.4	Low----- Low-----	0.17 0.17	5	2	4-8
RoA, RoB, RoC, RoD----- Rosholt	0-7 7-18 18-30 30-35 35-60	4-10 3-12 6-18 4-16 0-5	1.50-1.60 1.70-1.80 1.65-1.75 1.55-1.65 1.55-2.20	0.6-6.0 0.6-6.0 0.6-6.0 0.6-6.0 >6.0	0.10-0.18 0.10-0.22 0.09-0.22 0.04-0.16 0.02-0.04	4.5-7.3 4.5-7.3 4.5-7.3 4.5-7.3 5.1-6.5	Low----- Low----- Low----- Low----- Low-----	0.24 0.24 0.24 0.10 0.10	4	3	1-2
RrB: Rosholt-----	0-7 7-18 18-30 30-35 35-60	4-10 3-12 6-18 4-16 0-5	1.50-1.60 1.70-1.80 1.65-1.75 1.55-1.65 1.55-2.20	0.6-6.0 0.6-6.0 0.6-6.0 0.6-6.0 >6.0	0.10-0.18 0.10-0.22 0.09-0.22 0.04-0.16 0.02-0.04	4.5-7.3 4.5-7.3 4.5-7.3 4.5-7.3 5.1-6.5	Low----- Low----- Low----- Low----- Low-----	0.24 0.24 0.24 0.10 0.10	4	3	1-2
Rock outcrop.											
RsA----- Rousseau	0-8 8-30 30-60	2-12 0-10 0-10	1.27-1.56 1.26-1.60 1.48-1.67	2.0-6.0 6.0-20 6.0-20	0.10-0.12 0.06-0.08 0.05-0.07	5.1-6.0 4.5-6.5 5.6-6.5	Low----- Low----- Low-----	0.15 0.15 0.15	5	2	1-2
Sb----- Seelyeville	0-60	---	0.10-0.25	2.0-6.0	0.35-0.45	4.5-7.3	-----	---	---	8	>25
SfB, SfC, SfD----- Shawano	0-7 7-29 29-60	2-8 1-3 1-3	1.10-1.35 1.45-1.70 1.50-1.70	6.0-20 6.0-20 6.0-20	0.11-0.13 0.07-0.09 0.05-0.08	4.5-7.3 5.1-6.5 5.6-7.8	Low----- Low----- Low-----	0.17 0.17 0.17	5	2	.5-1
SyA----- Symco	0-8 8-26 26-60	10-25 18-30 15-30	1.35-1.55 1.55-1.65 1.65-1.80	0.6-2.0 0.2-0.6 0.2-0.6	0.15-0.24 0.11-0.20 0.10-0.20	6.6-7.8 6.1-8.4 7.4-8.4	Low----- Moderate----- Low-----	0.24 0.32 0.32	5	5	4-7
TlB, TlC2----- Tilleda	0-10 10-44 44-60	10-16 18-30 15-30	1.35-1.65 1.55-1.65 1.65-1.80	0.6-2.0 0.6-2.0 0.6-2.0	0.17-0.24 0.13-0.18 0.12-0.18	5.1-7.3 5.1-7.3 5.1-7.8	Low----- Moderate----- Low-----	0.32 0.24 0.24	5	5	2-4
TuB----- Tustin	0-9 9-28 28-30 30-42 42-60	4-10 2-8 15-25 30-60 1-4	1.55-1.70 1.55-1.70 1.60-1.65 1.65-1.95 1.50-1.65	6.0-20 6.0-20 0.2-2.0 0.06-0.2 6.0-20	0.07-0.12 0.06-0.11 0.12-0.19 0.09-0.20 0.05-0.07	5.6-7.3 5.6-7.3 6.1-7.3 6.1-7.3 6.1-7.3	Low----- Low----- Moderate----- High----- Low-----	0.17 0.17 0.32 0.32 0.15	4	2	.5-1
UdC. Udipsamments											
Wa----- Wainola	0-9 9-25 25-60	0-10 2-12 0-10	1.35-1.50 1.35-1.45 1.25-1.50	6.0-20 6.0-20 6.0-20	0.10-0.12 0.06-0.11 0.05-0.07	5.1-6.5 5.1-6.5 5.6-6.5	Low----- Low----- Low-----	0.15 0.15 0.15	5	2	2-4
Wd----- Waupaca	0-9 9-60	5-15 2-18	1.20-1.65 1.60-1.70	0.6-2.0 0.2-0.6	0.22-0.24 0.08-0.13	6.6-7.8 6.6-8.4	Low----- Low-----	0.32 0.43	5	5	4-7
WeA----- Wega	0-9 9-60	5-15 1-15	1.20-1.65 1.60-1.70	0.6-2.0 0.2-0.6	0.22-0.24 0.08-0.13	6.6-7.8 6.6-8.4	Low----- Low-----	0.37 0.37	5	5	2-4
WhB, WhC2----- Whalan	0-7 7-35 35	18-25 18-35 ---	1.30-1.45 1.40-1.55 ---	0.6-2.0 0.6-2.0 ---	0.22-0.24 0.17-0.19 ---	5.6-7.3 5.1-6.5 ---	Low----- Low----- ---	0.32 0.32 ---	4	6	1-2

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	<u>In</u>	<u>Pct</u>	<u>G/cm<sup>3</sup></u>	<u>In/hr</u>	<u>In/in</u>	<u>pH</u>					<u>Pct</u>
WvB----- Whalan Variant	0-11	4-10	1.35-1.65	2.0-6.0	0.09-0.12	5.6-7.8	Low-----	0.17	4	2	<1
	11-15	4-10	1.35-1.65	2.0-6.0	0.08-0.11	5.6-7.8	Low-----	0.17			
	15-24	27-35	1.40-1.55	0.6-2.0	0.12-0.20	5.6-7.8	Moderate----	0.43			
	24	---	---	---	---	---	-----	---			
ZzB----- Zurich	0-7	20-27	1.15-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low-----	0.37	5-4	6	2-3
	7-20	25-35	1.35-1.55	0.6-2.0	0.18-0.22	4.5-7.8	Moderate----	0.37			
	20-60	5-25	1.25-1.55	0.6-6.0	0.14-0.22	7.4-8.4	Low-----	0.37			

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth Ft	Kind	Months	Depth In	Hardness			Uncoated steel	Concrete
Ax*----- Angelica	B/D	None-----	---	---	+1-1.0	Apparent	Oct-Jun	>60	---	---	High-----	High-----	Low.
BoB, BrB----- Borth	C	None-----	---	---	2.0-6.0	Apparent	Oct-May	>60	---	---	Moderate	High-----	Low.
BxA: Borth-----	C	None-----	---	---	2.0-6.0	Apparent	Oct-May	>60	---	---	Moderate	High-----	Low.
Nebago-----	C	None-----	---	---	1.0-3.0	Perched	Oct-May	>60	---	---	Moderate	High-----	Low.
Meehan-----	B	None-----	---	---	1.0-3.0	Apparent	Oct-May	>60	---	---	Moderate	Low-----	Moderate.
Cm:* Cathro-----	A/D	Frequent----	Long-----	Nov-Jun	+1-1.0	Apparent	Nov-Jun	>60	---	19-22	High-----	High-----	Low.
Markey-----	A/D	Frequent----	Long-----	Nov-Jun	+1-1.0	Apparent	Nov-Jun	>60	---	25-30	High-----	High-----	Low.
EcC, EcD: Elderon-----	A	None-----	---	---	>6.0	---	---	>60	---	---	Low-----	Low-----	Moderate.
Rosholt-----	B	None-----	---	---	>6.0	---	---	>60	---	---	Moderate	Low-----	Moderate.
Fa*----- Fordum	D	Frequent----	Long-----	Mar-Jun	+1-1.0	Apparent	Jan-Dec	>60	---	---	High-----	High-----	High.
HnB, HrC2, HrD2- Hortonville	B	None-----	---	---	>6.0	---	---	>60	---	---	Moderate	Low-----	Moderate.
KbB, KbC, KbD--- Kennan	B	None-----	---	---	>6.0	---	---	>60	---	---	Moderate	Low-----	High.
KrB, KrC, KrD--- Kranski	B	None-----	---	---	>6.0	---	---	>60	---	---	Low-----	Low-----	Moderate.
Lx*----- Loxley	A/D	None-----	---	---	+1-1.0	Apparent	Nov-May	>60	---	50-55	High-----	High-----	High.
Mh----- Meehan	B	None-----	---	---	1.0-3.0	Apparent	Oct-May	>60	---	---	Moderate	Low-----	Moderate.
M1A----- Meehan	B	None-----	---	---	1.0-3.0	Perched	Mar-May	>60	---	---	Moderate	Low-----	Low.
Mp*----- Menasha	D	None-----	---	---	+1-1.0	Perched	Oct-Jun	>60	---	---	High-----	High-----	Low.
MrB----- Military	B	None-----	---	---	>6.0	---	---	20-40	Soft	---	Moderate	Low-----	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth <u>Ft</u>	Kind	Months	Depth <u>In</u>	Hardness			Uncoated steel	Concrete
Ms*----- Minocqua	B/D	Occasional	Brief-----	Nov-May	+1-1.0	Apparent	Nov-May	>60	---	---	High-----	High-----	High.
Ne----- Nebago	C	None-----	---	---	1.0-3.0	Perched	Oct-May	>60	---	---	Moderate	High-----	Low.
NhA----- Neenah	C	None-----	---	---	1.0-3.0	Perched	Oct-May	>60	---	---	High-----	High-----	Low.
OeA----- Oesterle	C	None-----	---	---	1.0-3.0	Apparent	Oct-May	>60	---	---	High-----	Low-----	Moderate.
OsB----- Oshkosh	C	None-----	---	---	>6.0	---	---	>60	---	---	Moderate	High-----	Low.
Pe. Pits													
PfA, PfB, PfC, PfD----- Plainfield	A	None-----	---	---	>6.0	---	---	>60	---	---	Low-----	Low-----	High.
PlB----- Plainfield	A	None-----	---	---	>6.0	---	---	>60	---	---	Low-----	Low-----	Moderate.
PmA----- Plainfield	A	None-----	---	---	4.0-6.0	Apparent	Dec-Jun	>60	---	---	Low-----	Low-----	High.
Pt*----- Poy	D	None-----	---	---	+1-1.0	Perched	Nov-May	>60	---	---	High-----	High-----	Low.
RfA, RfB, RfC--- Richford	A	None-----	---	---	>6.0	---	---	>60	---	---	Low-----	Low-----	Moderate.
Rm*----- Roscommon	A/D	None-----	---	---	+1-1.0	Apparent	Sep-Jun	>60	---	---	Moderate	High-----	Low.
RoA, RoB, RoC, RoD----- Rosholt	B	None-----	---	---	>6.0	---	---	>60	---	---	Moderate	Low-----	Moderate.
RrB: Rosholt----- Rock outcrop.	B	None-----	---	---	>6.0	---	---	>60	---	---	Moderate	Low-----	Moderate.
RSA----- Rousseau	A	None-----	---	---	2.5-6.0	Apparent	Feb-May	>60	---	---	Low-----	Low-----	Moderate.
Sb*----- Seelyeville	A/D	Frequent-----	Long-----	Nov-May	+2-2.0	Apparent	Jan-Dec	>60	---	50-55	High-----	High-----	Moderate.
SfB, SfC, SfD--- Shawano	A	None-----	---	---	>6.0	---	---	>60	---	---	Low-----	Low-----	High.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness			Uncoated steel	Concrete
					<u>Ft</u>			<u>In</u>		<u>In</u>			
SyA----- Symco	C	None-----	---	---	1.0-3.0	Apparent	Nov-May	>60	---	---	High-----	Moderate	Low.
TlB, TlC2----- Tilleda	B	None-----	---	---	>6.0	---	---	>60	---	---	Moderate	Low-----	Moderate.
TuB----- Tustin	B	None-----	---	---	>6.0	---	---	>60	---	---	Moderate	Moderate	Low.
UdC. Udipsamments													
Wa----- Wainola	B	None-----	---	---	1.0-2.0	Apparent	Nov-May	>60	---	---	Moderate	Low-----	Moderate.
Wd*----- Waupaca	B/D	Frequent-----	Long-----	Mar-Jun	+1-1.0	Perched	Oct-May	>60	---	---	High-----	High-----	Low.
WeA----- Wega	B	None-----	---	---	1.0-3.0	Perched	Oct-May	>60	---	---	High-----	Moderate	Low.
WhB, WhC2----- Whalan	B	None-----	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Moderate	Low.
WvB----- Whalan Variant	B	None-----	---	---	>6.0	---	---	20-40	Hard	---	Moderate	Moderate	Low.
ZzB----- Zurich	B	None-----	---	---	4.0-6.0	Apparent	Feb-Apr	>60	---	---	High-----	Moderate	Moderate.

\* In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

TABLE 18.--ENGINEERING INDEX TEST DATA

[Absence of an entry indicates that no determination was made]

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve--*				Percentage smaller than--*				Liquid limit	Plasticity index	Classification	
				Max. dry density	Optimum moisture	No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	Unified
			In	lb/cu ft	Pct									Pct			
Borth sandy loam:** SW1/4, SW1/4, sec. 34, T. 21 N., R. 13 E.	Clayey water-laid deposits over sand.	S77WI-135-6	17-29	---	---	---	100	97	83	83	83	78	64	56	32	A-7-6 (19)	CH
			29-60	---	---	---	100	84	2	2	2	2	2	--	NP	A-3(0)	SP
Borth silty clay loam:** SW1/4, SW1/4, sec. 32, T. 21 N., R. 14 E.	Clayey water-laid deposits over sand.	S77WI-135-5	7-25	---	---	---	100	97	92	91	91	79	59	63	39	A-7-6 (20)	CH
			27-41	---	---	---	100	98	5	4	3	2	1	--	NP	A-3(0)	SP-SM
Hortonville fine sandy loam: SE1/4, NE1/4, sec. 18, T. 21 N., R. 13 E.	Loamy deposits over loamy glacial till.	S78WI-135-6	16-22	---	---	97	95	90	69	67	60	43	33	38	20	A-6(11)	CL
			28-60	123	11	90	87	77	44	40	28	12	7	18	5	A-4(2)	SC-SM
Menasha silty clay: SW1/4, SW1/4, sec. 17, T. 22 N., R. 14 E.	Clayey water-laid deposits.	S77WI-135-2	12-20	---	---	---	---	100	97	96	94	80	59	66	40	A-7-6 (20)	CH
			32-60	---	---	---	---	100	99	98	98	91	69	61	40	A-7-6 (20)	CH
Neenah silty clay:** NW1/4, SE1/4, sec. 17, T. 22 N., R. 14 E.	Clayey water-laid deposits.	S77WI-135-1	8-14	---	---	---	100	99	97	96	96	76	47	57	34	A-7-6 (19)	CH
			25-60	---	---	---	---	100	98	98	97	90	67	66	45	A-7-6 (20)	CH
Oshkosh silty clay loam: SW1/4, SE1/4, sec. 17, T. 22 N., R. 14 E.	Clayey water-laid deposits.	S77WI-135-3	16-24	---	---	---	---	100	98	98	97	83	60	60	34	A-7-6 (20)	CH
			28-60	96	24	---	100	97	93	93	92	83	60	57	35	A-7-6 (20)	CH
Poy clay loam: SW1/4, NW1/4, sec. 33, T. 21 N., R. 14 E.	Clayey water-laid deposits over sand.	S77WI-135-4	16-25	---	---	---	100	99	92	92	91	83	70	72	45	A-7-6 (20)	CH
			27-60	---	---	---	100	98	4	3	3	2	2	--	NP	A-3(0)	SP
Rosholt sandy loam: SW1/4, SE1/4, sec. 1, T. 23 N., R. 14 E.	Loamy and sandy deposits over stratified sand and gravel.	S79WI-135-3	18-26	---	---	97	94	74	32	31	26	17	14	26	12	A-2-6 (0)	SC

TABLE 18.--ENGINEERING INDEX TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density		Percentage passing sieve--*				Percentage smaller than--*				Liquid limit	Plasticity index	Classification	
				Max. dry density	Optimum moisture	No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	Unified
			In	lb/cu ft	Pct									Pct			
Waupaca silt loam: NE1/4, SW1/4, sec. 17, T. 25 N., R. 15 E.	Silty water-laid deposits.	S77WI-135-10	13-20 30-60	--- ---	--- ---	--- ---	--- ---	100 100	98 99	92 96	50 56	18 16	12 9	26 21	NP NP	A-4(8) A-4(8)	MI ML
Wega silt loam: NE1/4, SW1/4, sec. 15, T. 25 N., R. 15 E.	Silty water-laid deposits.	S77WI-135-7	13-19 19-31	--- ---	--- ---	--- ---	--- ---	100 100	95 92	81 78	33 33	11 7	7 4	23 21	NP NP	A-4(8) A-4(8)	ML ML
Whalan loam:** NW1/4, NW1/4, sec. 24, T. 21 N., R. 14 E.	Loamy deposits over dolomitic limestone.	S78WI-135-4	11-29	---	---	---	100	97	77	74	68	51	38	47	25	A-7-6 (16)	CL
Zurich silt loam:** SE1/4, SE1/4, sec. 35, T. 21 N., R. 13 E.	Silty water-laid deposits over stratified loamy and silty deposits.	S78WI-135-3	9-16 20-40	---	---	---	100	99 100	96 98	89 92	55 51	23 9	19 4	34 22	11 NP	A-6(8) A-4(8)	CL ML

\* Mechanical analysis according to the AASHTO Designation T88-57 (1). Results from this procedure can differ somewhat from the results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by hydrometer method and the various grain-size fractions are calculated on the basis of all material up to and including that 3 inches in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from the calculation of grain-size fraction. The mechanical analysis data used in this table are not suitable for use in naming textural classes of soils.

\*\* These soils are taxadjuncts. See the series description for explanation.

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Angelica-----	Fine-loamy, mixed, nonacid, frigid Aeric Haplaquepts
*Borth-----	Clayey over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs
Cathro-----	Loamy, mixed, euic Terric Borosapristis
Elderon-----	Sandy-skeletal, mixed, frigid Typic Dystrochrepts
Fordum-----	Coarse-loamy, mixed, nonacid, frigid Mollic Fluvaquents
Hortonville-----	Fine-loamy, mixed, mesic Glossoboric Hapludalfs
Kennan-----	Coarse-loamy, mixed Typic Glossoboralfs
*Kranski-----	Sandy, mixed, mesic Typic Hapludalfs
Loxley-----	Dysic Typic Borosapristis
Markey-----	Sandy or sandy-skeletal, mixed, euic Terric Borosapristis
Meehan-----	Mixed, frigid Aquic Udipsamments
Menasha-----	Very-fine, mixed, mesic Typic Haplaquolls
*Military-----	Fine-loamy, mixed, mesic Typic Hapludalfs
*Minocqua-----	Coarse-loamy over sandy or sandy-skeletal, mixed, nonacid, frigid Typic Haplaquepts
Nebago-----	Sandy over clayey, mixed, mesic Aquic Dystric Eutrochrepts
*Neenah-----	Very-fine, mixed, mesic Aquollic Hapludalfs
Oesterle-----	Coarse-loamy, mixed Aquic Glossoboralfs
Oshkosh-----	Very-fine, mixed, mesic Typic Hapludalfs
Plainfield-----	Mixed, mesic Typic Udipsamments
Poy-----	Clayey over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Richford-----	Sandy, mixed, mesic Psammentic Hapludalfs
Roscommon-----	Mixed, frigid Mollic Psammaquents
Rosholt-----	Coarse-loamy, mixed Typic Glossoboralfs
Rousseau-----	Sandy, mixed, frigid Entic Haplorthods
Seelyeville-----	Euic Typic Borosapristis
Shawano-----	Mixed, frigid Typic Udipsamments
Symco-----	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Tilleda-----	Fine-loamy, mixed Typic Glossoboralfs
Tustin-----	Clayey, mixed, mesic Arenic Hapludalfs
Udipsamments-----	Mixed, Typic Udipsamments
Wainola-----	Sandy, mixed, frigid Entic Haplaquods
Waupaca-----	Coarse-silty, mixed, nonacid, frigid Mollic Fluvaquents
Wega-----	Coarse-silty, mixed, nonacid, frigid Aquic Udifluvents
Whalan-----	Fine-loamy, mixed, mesic Typic Hapludalfs
Whalan Variant-----	Fine-loamy, mixed, mesic Typic Hapludalfs
*Zurich-----	Fine-silty, mixed, mesic Typic Hapludalfs

\* The soil is a taxadjunct to the series. See text for description of those characteristics that are outside the series.



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